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Nursery & Market Garden Industries'

- - Development Society, Limited. - -

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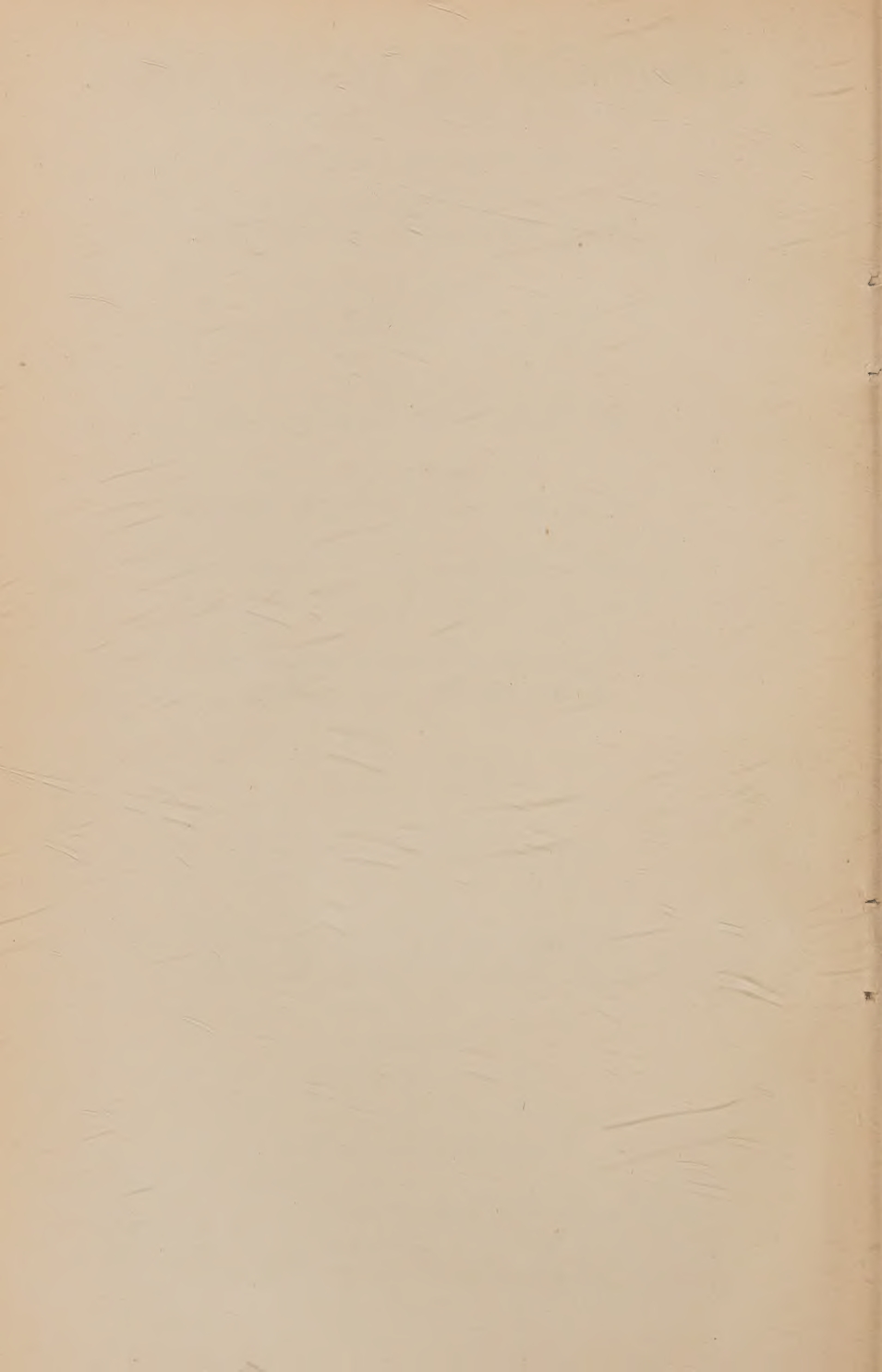


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Introduction.

ANY attempt to review the work of 1926 would not be complete without reference to the difficulties which growers of glasshouse plants had to face during this period. On the average, crops have been low, owing to unsuitable weather conditions, and prices have also suffered by reason of industrial unrest.

Nevertheless, it is pleasing to note, as in previous years, the continued interest in the investigations which is shown by all growers, owners and workmen alike. During 1926, thirty-five new members have been enrolled. This is a useful increase in face of the unsatisfactory season, but still more support is necessary if the Station is to continue its activities unhampered by lack of funds. The governing body trusts that each member will advertise the advantages which are to be derived from contact with the Station, and looks forward to the day when it will have the support of every grower of glasshouse crops in the country.

Evening lectures for nursery employees begun in 1925, were continued during the winter 1925-26. The following subjects were discussed :—

- | | |
|-------------|--|
| Nov. 8th. | The importance of soil organisms to crop production. |
| Nov. 19th. | Principles of pest control. |
| Dec. 3rd. | The soil as a source of plant foods. |
| Dec. 17th. | Pollination and fertilisation of flowers. |
| Jan. 28th. | Temperature in relation to health and disease. |
| Feb. 11th. | Forest Entomology in the United States. |
| Feb. 25th. | The use of lime on soils. |
| March 11th. | Water in relation to health and disease. |

These lectures were well attended and stimulated interesting discussions.

Manurial and crop management trials with the tomato have been continued, and some useful facts are indicated. Further evidence has been obtained that the manurial treatment practised by growers is much in excess of crop requirement. Thus growers usually apply between 30 and 50 tons stable manure per acre to the soil before planting, while some have been known to use 80 tons per acre. In an experiment conducted during 1926 for the first time, stable manure was used at the rate of 15, 30, 60 and 90 tons per acre on different plots in duplicate.

The usual quantity of artificials was also applied both before planting and as top dressings. No significant difference either in vegetative growth or weight of crop was noticed between any of the plots, and so far as one season's trial is concerned, no benefit was seen by increasing the dressing beyond 15 tons per acre under our conditions. The result is the more surprising because the soil had received no stable manure during the three previous years.

The addition of freshly cut grass to the soil before planting again increased the yield from tomatoes grown in it, but the difference was less than that obtained during 1925.

A new series of experiments was devised to determine the effect of increasing the quantity of water supplied during the season, and of starting watering 14 days earlier than usual. No benefit resulted from increasing the normal quantity of water given by 50% and 100%. By commencing to water after the second truss had set, instead of waiting until the setting of the third truss, earlier picking was obtained, but the total crop was not improved.

Further observations on blotchy ripening of tomato fruits have confirmed previous reports, that it is a form of malnutrition in respect of nitrogen and potash. They have also shown that blotchy ripening can occur when the soil is liberally supplied with both nitrogen and potash, if either the root action be injured by parasitic organisms or the subsoil dry. A dry subsoil is an important cause of failure of the tomato crop. It cannot be corrected during the growing season, but only by thorough winter flooding of the soil.

The manurial and sterilisation experiments with cucumbers have been continued. Experiments were started in 1922 to study the many influences at work in the base, or soil upon which the beds are placed, with the object of obtaining information which would assist growers to improve their crops. The results were summarised last year. The following advances have been made during 1926 :—Beds used for one season were sterilised by means of formaldehyde, cresylic acid, emulsified cresylic acid and steam. Formaldehyde and emulsified cresylic acid were without effect; cresylic acid gave a slight increase; steam gave the best result and increased the yield beyond that obtained from a new bed.

Synthetic manure prepared by the A.D.C.O. process was compared with stable manure in cucumber beds. The beds composed of two parts loam and one part A.D.C.O. proved to be slightly better than those made of two parts loam and one part stable manure.

Investigations on the control of Red Spider have been continued. In tomato houses where naphthalene fumigation is uncertain as a treatment for this pest, early spraying with liver of sulphur and soft soap has considerably checked severe outbreaks. This spray must be made with soft water to avoid hardening of foliage and marking of fruit.

A parasite of White Fly has been reared, and there are grounds for belief that this may prove a very important agent in its control.

Failure of a crop of strawberries grown under glass in 1925 led to the identification of the old tomato "canker" fungus, *Diplodina lycopersici*, as an important disease of the strawberry. Investigations since that time have shown the disease to be widespread, both under glass and in the open. Methods of control are under examination.

Some 200 different varieties and strains of tomatoes have been tested for resistance to *Cladosporium fulvum*. Two strains show marked resistance, but not immunity.

Observations over a period of three seasons indicate that Mosaic disease of cucumbers can be avoided under glass by the use of disease free seed, a small quantity of which is kept going at the station.

Fusarium wilt of the carnation has been prevented on commercial nurseries by carefully conducted steam sterilisation of the soil.

Experiments on the fertilising effect of carbon dioxide on glasshouse plants have been continued. The earlier conclusion that daily treatment for 1 to 1½ hours, with atmospheres containing not more than 1% carbon dioxide, is beneficial to tomatoes has been amply confirmed. An apparatus for the continuous supply of carbon dioxide has been useless, but a stove burning patent fuel, which burns almost completely to carbon dioxide, has given promising results, in a small chamber in which 56 tomato plants were grown. Where this stove was used during 2 hours in the morning, and a similar period in the afternoon, the crop was increased from 16% to 30%.

A number of soils from commercial nurseries have been analysed. While new soils are uniformly deficient in carbonates, cultivated soils often contain as much as 5% total carbonates expressed as calcium carbonate. Similarly, potash and phosphoric acid are always present in appreciable amounts in cultivated soils. The main chemical work during the year has been the analysis of tomato plants. On a poor soil the ratio of nitrogen,

phosphoric acid and potash in the plant, is approximately 5 : 1 : 3 while on a well-manured soil it is $4\frac{1}{2}$: 1 : 9. These analyses are being extended to plants grown in soils which are deficient in nitrogen, potash and phosphoric acid respectively. An attempt is also being made to determine the extent to which these three nutrients are removed from the soil by plants at various stages in their life history.

The toxic effect of a number of chemical agents has been tested on *Colletotrichum atramentarium* (= *C. tabificum*). None is as effective as cresylic acid. The efficiency of this compound appears to depend on actual contact with the sclerotia of the fungus rather than on any effect of its vapour.

The investigation of the "maturation period," or number of days between the opening of the flower and the picking of tomato fruits, has been continued.

Further work has been done in preparing soil for seed boxes to be used in tomato culture, and a report is included.

Through the generosity of the International Education Board, Dr. I. C. Jagger spent twelve months at the station, devoting his attention to the susceptibility of tomato plants to *Cladosporium fulvum*.

Miss A. P. Wilson, who was awarded a Ministry of Agriculture Scholarship in 1925, worked at the station during 1925-1926, and investigated the problem of cucumber root-rot.

DIRECTOR'S REPORT.

1. The Tomato Crops of 1925 and 1926.

It is common knowledge that the tomato crops of 1925 and 1926 were lighter than those of any of the previous three years, and it may be of interest to growers to know some of the main causes which investigation has shown reduced the yield.

In both years the weight of fruit picked from the five bottom trusses was up to the average, and in both years the top crop failed ; but the cause of failure was not the same in the two years.

In 1925 a period of dry sunny weather occurred when the sixth to eighth trusses were flowering. The dry atmospheric conditions were most unfavourable to setting of the fruits, and the trusses were very poor. The climate of this country is proverbially variable, and growers cannot be blamed for not taking the precaution of shading their houses and increasing the humidity of the atmosphere as experiment showed they should have done. In several instances under observation, where the atmosphere was moistened and the houses were shaded, the " set " was perfect, while neighbouring houses where these precautions were not taken, showed the usual poor top crop. Growers should profit by this lesson, and take the first opportunity of themselves proving the value of applying a light shading to the glass during the heat of summer. The shading should be carefully done, because excessive shade is probably as harmful as no shade at all. Experiment has shown that a light shading with flour and water is satisfactory. It breaks the intense heat of the sun, without causing excessive shade.

In 1926, the cause of the failure on the tops is not so easily traced, for the damage was done in the Spring, when there were two causes of root injury. The first and most important of these was the dryness of the soil. The reason for this dryness is not understood, but the fact remains that tomato soils under glass dried out some three weeks earlier this year than during the past seven years. Unfortunately for growers, the plants showed no signs of lack of water, until the finer rootlets were injured. Dryness of the soil round the roots renders them particularly

susceptible to attack by the black dot fungus, *Colletotrichum atramentarium*, which usually does not attack tomato roots until the end of the season, when the plant has been weakened by its crop. The second cause was the persistence of cold nights, which lowered the soil temperature appreciably. Both causes led to the roots becoming infected by the black dot fungus, which continues to ramify slowly through the tissues of the root once it has gained entrance to them. Indeed, root injury was apparent throughout the season. When the tops developed, the fruits set well, and there was every promise of a good top crop, but as most growers know, the fruit did not swell properly, and the evidence indicates that the immediate cause of this was poor root action. This failure should convince all of the need for keeping the soil uniformly moist and warm in the Spring. A dry subsoil is a common cause of failure of the tomato crop, and winter flooding on soils where this is possible, with some 200,000 gallons of water per acre, will do much to correct it. The matter does not end there, however, because between the time of planting out, until regular watering begins, there is danger of the "ball" becoming too dry, especially if the plants were raised in baked soil. "Ball" watering is a necessary and important detail of spring work.

2. Experimental Results of 1926.

The practice of grading the tomato fruits from the experimental plots, adopted in 1921, was continued during the present season. The fruits are collected from each plot in numbered baskets, and graded into seven grades as follows:—

- A.—"Pinks" number 5 to 7 and "Pink and Whites" 8 to 10 to the lb. These are the best quality of fruit in size, shape and colour; "Pinks" being slightly larger than "Pink and Whites."
- B.—"Whites." These are fruit of good colour, but smaller than "Pink and Whites."
- C.—"Blues." This grade consists of fruit of good colour, but larger and more irregular in shape than Grade A.
- D.—"Roughs." Small misshapen fruits about the size of cherries.
- E.—Blotchy fruits which ripen irregularly.
- F.—Fruits showing Blossom End Rot.
- G.—Fruits showing the lesions of "Stripe Disease."

A. Manurial Experiments with Tomatoes.

(a) Series G. Stable Manure Experiment.

As tomato house 1, series G, had no stable manure during 1924 and 1925, it seemed a suitable place in which to test the effect of varying amounts of this manure as a base dressing for tomatoes. For this purpose the house was divided into eight equal plots. These were treated in duplicate, the pairs receiving stable manure at the rate of 15, 30, 60 and 90 tons per acre respectively. The entire house also received the usual base and top-dressing fertilisers. The results obtained are surprising. No difference in vegetative growth was observed between the different plots, and as Table 1 shews there was no significant difference in crop. The present season, as already indicated, has been an abnormal one, because the top crop was adversely affected by the weather, and also fuel was not available for heating the houses at the end of the season. Thus the above results may be due in part to unfavourable conditions, and the experiment will be repeated.

Table 1.

Plot.	Rate of applying Stable Manure.	Crop Yield.		
		Lbs. per plant.	Tons per acre.	Average tons per acre.
G1	15 tons per acre	5.20	39.52	36.25
G6	15 " "	4.34	32.98	
G2	30 " "	4.55	34.58	33.33
G5	30 " "	4.22	32.07	
G4	60 " "	4.18	31.76	32.18
G7	60 " "	4.29	32.60	
G3	90 " "	4.11	31.23	32.91
G8	90 " "	4.55	34.58	

Full details are given in Tables I. to VIII. in the Appendix.

(b) Series H. Watering Experiment.

This experiment was arranged to determine (1) if the earliness of the crop is affected by the time of applying the first real watering, "ball watering" in the early stages being disregarded, and (2) if heavier crops can be obtained by increasing the quantity

of water given at each watering. The water was applied through a one-inch hose, which delivered 25 gallons of water per minute. In the normal watering, the hose was used for 8 minutes per plot during the early part of the season, the quantity of water applied being at the rate of 29,000 gallons per acre. Details of the different applications are shewn below in Table 2.

Table 2.

Plot.	Treatment.	Date of First Watering.	Quantity of water in gallons applied per acre once a week.	
			19/4/26 to 8/6/26.	15/6/26 to 23/9/26.
1	Normal watering begun 10 days earlier than other plots ...	19/4/26	29,000	58,000
6	" " " " "	"	29,000	58,000
2	Normal watering ...	29/4/26	29,000	58,000
5	" " ...	"	29,000	58,000
4	50% more water than normal ...	"	43,500	87,000
7	" " " " ...	"	43,500	87,000
3	100% more water than normal...	"	58,000	116,000
8	" " " " ...	"	58,000	116,000

In plots 1 and 6, the first watering was applied just before the opening of the third truss. Ten days later, when the rest of the house was watered, most of the flowers on the third truss had set and the fourth truss was opening. As can be seen from Table 3, there was no appreciable difference between the crops from the different treatments, but actually fruit was picked from the first watered plots, six days earlier than from the rest of the house, and also the plants were more vigorous. The experiment suggested that the earlier watering was beneficial, and it will be repeated in 1927. Details of crop production are given in the Appendix, Tables IX. to XVI.

(c) Series J and K.

These experiments were designed to determine the correct proportions of nitrogenous, phosphatic and potassic fertilisers in a satisfactory tomato mixture. The results from Series J. are summarised in Table 4 and set out in detail in the Appendix, Tables XVII. to XLIII.

Plot J1, which has previously received a double dressing of complete artificials, was devoted to a new experiment. It was divided into two half plots, each of which received 14 lbs. stable

manure per square yard in the base, and was top dressed with a mixture of sulphate of ammonia and sulphate of potash in equal proportions. One half plot, J1b, received in addition 14 lbs. grass per square yard in the base. There was no significant difference in yield.

Table 3.

Plot.	Treatment.	Crop Yield.		
		Lbs. per plant.	Tons per acre.	Average tons per acre.
1	Normal watering begun 10 days earlier than other plots.	4.54	34.50	33.82
6	" " " "	4.36	33.14	
2	Normal watering	4.21	31.99	32.94
5	" " " "	4.46	33.89	
4	50% more water than normal ...	4.44	33.75	31.58
7	" " " " ...	3.87	29.41	
3	100% more water than normal...	4.49	34.12	32.91
8	" " " " ...	4.17	31.69	

In 1925, Plot J2, previously unmanured was divided into two plots, one of which was left unmanured, while the other received 14 lbs. stable manure per square yard. The unmanured plot yielded at the rate of 26.56 tons per acre, while the manured plot gave 35.8 tons per acre, an increase of 34.5%. In 1926, the unmanured plot was left as before, while the manured plot was again subdivided, one-half receiving no additional manure, and the other 28 lbs. stable manure per square yard. The plot unmanured for nine years, J2a, gave 21.35 tons per acre with 43.04% blotchy fruit, while J2b, manured in 1925, gave 28.37 tons per acre with 20.98% blotchy fruit, and J2c, which received 28 lbs. stable manure per square yard this year, yielded 25.76 tons per acre with 14.44 per cent. blotchy fruit.

The previous results from Plots J6a to J6d, J7a to J7d, J8a to J8d, which receive increasing amounts of phosphate, nitrogen and potash, respectively, indicated that 7½% of nitrogen gives bigger crops than smaller quantities; that 10% of potash does not increase the yield over that produced by 5% potash, although the heavier dressing is necessary to reduce the amount of blotchy fruit to a minimum; and that phosphates have little effect upon the crop. Consequently, it was decided to arrange trials in which the potash and phosphates were kept constant, while the

nitrogen was increased. Plots J3 and J4 were chosen, and divided each into four small plots. J3b received $2\frac{1}{2}\%$ nitrogen with 10% potash; J3c, 5% nitrogen with 10% potash; J3d, $7\frac{1}{2}\%$ nitrogen with 10% potash; and J3a potash only. Similar treatments were given to J4a, J4b, J4c and J4d, with the addition of 5% of phosphate to each plot. The only difference observed between the treatments is in the amount of blotchy fruit, as can be seen from Table 4. The experiment is to be repeated in 1927.

Table 4.

Plot.	Treatment	Lbs. per plant.	Tons per acre.	Per cent. blotchy fruit.
J1a	Stable Manure, sulphate of ammonia and sulphate of potash	3.82	29.03	2.10
J1b	Ditto, with grass	3.95	30.02	1.76
J2a	Unmanured	2.81	21.35	43.04
J2b	14 lbs. Stable Manure per sq. yd. in 1925	3.72	28.27	20.98
J2c	28 lbs. Stable Manure per sq. yd. in 1926	3.39	25.76	14.44
J3a	Sulphate of Potash only	5.15	39.14	6.00
J3b	$2\frac{1}{2}\%$ Nitrogen and 10% potash ...	4.54	34.50	5.07
J3c	5% Nitrogen and 10% potash ...	4.22	32.07	4.96
J3d	$7\frac{1}{2}\%$ Nitrogen and 10% potash ...	4.31	32.75	3.24
J4a	5% Phosphate and 10% potash	4.67	35.49	6.00
J4b	$2\frac{1}{2}\%$ Nitrogen, 5% phosphate and 10% potash	4.44	33.73	3.38
J4c	5% Nitrogen, 5% phosphate and 10% potash	3.75	28.50	7.19
J4d	$7\frac{1}{2}\%$ Nitrogen, 5% phosphate and 10% potash	4.28	32.53	3.72
J5a	Complete artificials	3.84	28.18	6.21
J5b	Ditto, with grass	3.75	28.50	5.86
J6a	Complete artificials without phosphates	4.31	32.75	5.80
J6b	8% Phosphates	4.23	32.15	3.30
J6c	16% Phosphates	4.09	31.08	4.38
J6d	24% Phosphates	4.29	32.60	2.33
J7a	Complete artificials without nitrogen	2.98	22.65	9.71
J7b	5% Nitrogen	4.32	32.83	7.65
J7c	$7\frac{1}{2}\%$ Nitrogen	4.43	33.67	4.51
J7d	10% Nitrogen	4.21	31.97	3.31
J8a	Complete artificials without potash	3.61	27.43	24.09
J8b	$7\frac{1}{2}\%$ Potash	4.38	33.28	13.25
J8c	10% Potash	4.33	32.90	8.08
J8d	$12\frac{1}{2}\%$ Potash	4.65	35.34	8.38

The complete artificial plot J5 was repeated and divided into two equal plots, J5a and J5b. J5a received a dressing of grass cuttings in addition to complete artificials, but it was without effect and will be repeated.

The treatments of J6a to J6d, J7a to J7d, and J8a to J8d were continued. J6a received no phosphates as before, while J6b, J6c and J6d were given 8, 16 and 24% phosphates respectively in the fertiliser mixture. As in previous years, no difference in weight or quality of crop was observed. J7a received no nitrogen, while J7b, J7c and J7d received 5, 7½ and 10% respectively. 5% of nitrogen as sulphate of ammonia gave a 50% increase over the untreated plot, but there was no advantage in increasing the dressing further, except that the quantity of blotchy fruit was reduced from 7.65% to 3.31%. J8a received no potash, while J8b, J8c and J8d were given 7½, 10 and 12½% respectively in the mixture. Here again an increase of the dressing beyond 7½% was of no benefit, except in reducing the amount of blotchy fruit. Series K. remained as in previous years, except that 14 lbs. grass cuttings per square yard were applied in the base to the north half of each plot. The results are summarised in Table 5 and detailed in the Appendix, Tables XLIV. to LI. It will be seen that the half plots receiving grass cutting gave a slightly higher yield in each case, except where phosphates were omitted.

Table 5.

Plot.	Treatment.	Lbs. per plant.	Tons per acre.	Per cent. blotchy fruit.
K1b	Twice complete artificials ...	3.39	25.76	2.05
K1a	Ditto, with grass ...	3.92	28.79	2.36
K2b	Unmanured ...	2.56	19.45	39.44
K2a	Grass only ...	2.86	21.73	43.71
K3b	Standard with complete artificials	4.07	30.93	4.17
K3a	Ditto, with grass ...	4.02	30.55	5.96
K4b	Complete artificials with dung ...	3.89	29.56	4.09
K4a	Ditto, with grass ...	4.08	31.00	4.65
K5b	Complete artificials ...	3.93	29.87	6.36
K5a	Ditto, with grass ...	4.20	31.92	5.23
K6b	Complete artificials without phosphate ...	4.32	32.83	4.63
K6a	Ditto, with grass ...	4.05	30.78	3.48
K7b	Complete artificials without nitrogen ...	3.10	23.56	12.98
K7a	Ditto, with grass ...	3.27	24.85	11.62
K8b	Complete artificials without potash	3.00	22.80	32.98
K8a	Ditto, with grass ...	3.37	25.61	34.71

The results of these experiments are unsatisfactory and they will be repeated in 1927, because 1926 was an abnormal year in many respects and the results cannot be relied upon.

(d) Series M. Variety Trials.

These trials were commenced in 1923 to test the newer varieties against those of established commercial excellence. The results emphasise the poorness of the 1926 crop. Water Baby,

which produced 44.83 tons per acre, heads the list. Comet, Comet x Manx Marvel, Beacham Lea and Kitchener's Selected gave the lowest yields. Ailsa Craig was beaten only by Water Baby and Marvel of the Market, the latter of which produced coarse fruit unsuitable for the English market. The yields are summarised in Table 6.

Table 6.

Variety.	Grade : Tons per acre.							Total tons per acre.	Per cent. of blotchy fruit.
	A	B	C	D	E	F	G		
Riverside Favourite	18.82	4.69	10.46	.58	1.63	—	.42	36.60	4.49
Ailsa Craig ...	25.46	9.45	1.09	.45	.25	.02	1.04	37.79	.67
Yarmouth ...	18.37	4.10	12.89	.45	.41	—	.30	36.52	1.66
Water Baby ...	21.94	7.57	12.81	.79	.56	.07	1.09	44.83	1.13
Comet ...	19.38	3.06	7.29	.15	1.19	—	.72	31.79	3.62
Potentate ...	17.35	3.83	13.60	.86	1.29	.07	.45	37.45	3.41
Comet x Manx Marvel	20.71	3.42	6.88	.38	.64	—	.57	32.60	1.96
Radio ...	21.84	9.50	2.30	.63	.40	—	1.27	35.94	1.07
Marvel of the Market	13.43	2.07	21.11	.53	1.57	.10	.45	39.26	4.11
Beacham Lea ...	17.02	4.08	14.80	.76	1.19	.05	.65	28.55	3.09
Kitchener's Selected	18.70	7.30	3.19	.30	.91	—	.68	31.08	2.92

(e) Investigations concerning the reduction in yield of the Tomato crop by continuous cultivation on the same soil.

These experiments were begun in 1923, when four new houses were erected at the station for the purpose of the investigations. The crop records over the past four years show that a decreased yield varying from 0.35 lbs. per plant in P3, to 3.01 lbs. in O5, has now occurred. In 1923 the average weight of fruit per plant in the 22 plots in the three manured houses was 7.07 lbs., and in the six plots in the unmanured 4.25 lbs. In 1926 the average weight per plant in the manured 22 plots was 5.69 lbs., showing a decreased yield of 1.38 lbs. per plant, and in the unmanured 2.58 lbs., showing a decrease of 1.67 lbs.

In some of the plots in the manured houses certain experiments were tried, which either lessened or intensified the decrease. If these plots are omitted, and the average from all the others taken, it will be found that there is a very close similarity between the rate of decrease in both the manured and the unmanured houses. This point is worth noting, because although the application of manures has made the plants more productive, it has not materially affected the decrease which is common to both manured and unmanured land.

The records show that the fall in yield is not entirely consistent, for a higher yield was obtained from plots P6 and P7 during the second year than the first, and in one case, N7, the yield was higher in the third year than in the preceding two. During the third year five plots gave a higher yield than in the second, and in 1926 five plots gave a greater yield than in 1925.

These facts may perhaps be worth noting, because they suggest that the fall in crop is not due to any harmful factor formed in the soil itself or from the decomposing tomato roots.

In 1923 a quarter of a manured and a quarter of an unmanured house was left fallow. A large increase in weight followed when the fallowed land was first planted. Fallowing land after it has been cropped, as was done in 1925, does not increase the crop to the extent expected, for there was only an average increase on the three manured plots of 0.31 lbs. per plant, but on the unmanured plots the increase was 0.79 lbs. per plant. Taking this fact in conjunction with another in which the application to an unmanured plot of only 2 ozs. per square yard of a basic fertiliser containing $7\frac{1}{2}\%$ nitrogen, 5% phosphate and 10% potash, gave a higher yield than was obtained during the first year of cropping, it appears that the decrease is in some way connected with the nutriment taken up by the roots.

In 1925 an application of fresh grass cuttings increased the crop of a manured plot by 1.03 lbs. per plant, and that of an unmanured plot by 1.28 lbs. In 1926 the grass experiment was not so successful, for although an increase of 0.43 lbs. per plant followed in one case, in another a decrease of 0.89 lbs. occurred.

The plot to which partially decomposed grass was given shewed a decrease of 1.23 lbs. per plant. The crop on the plot to which steamed tomato haulms was applied also fell by 1.1 lbs. per plant. The plot to which A.D.C.O. (partly decomposed straw) was applied resulted in a slight increase in yield, but in the plot to which straw was added, the yield was raised by 0.58 lbs. per plant.

Thus a gradual decrease in crop has occurred in all the plots, whether manured or not, and it has been suggested that this fall is connected in some manner with the food supply. The actual decrease from plants growing on manured and unmanured plots is very similar in amount, but the percentage decrease on the unmanured is more than twice as great as on the manured. Records of the fallowing in 1925 show that it gave an increase of 0.31 lbs. per plant on manured soil and 0.79 lbs. on unmanured soil, a result which might naturally be expected if the food supply was a factor in the decrease.

The results are summarised in Table 7, and given in detail in the Appendix tables.

Table 7.

Plot.	Treatment.	Lbs. per plant.	Tons per acre.	Per cent. blotchy fruit.
N2	Manured ; Control	6.10	46.35	0.15
N8	" "	5.70	43.32	0.53
N10	" "	5.58	42.40	—
N3	$\frac{1}{4}$ oz. Magnesium sulphate per sq. yd. with first top dressing	5.62	42.71	—
N9	$\frac{1}{4}$ oz. Magnesium carbonate per sq. yd. with first top dressing	5.70	43.40	0.35
N1	14 lbs. grass cuttings per sq. yd. ...	6.22	47.28	0.49
N6	Fallow 1923 and 1924, cropped 1925 and 1926	6.53	49.62	0.93
N7	Fallow 1923 and 1925, cropped 1924 and 1926	6.12	47.28	—
O4	Manured ; Control	4.90	37.22	0.61
O6	" "	5.59	42.47	0.07
O8	" "	5.63	42.78	—
O1	A.D.C.O.	5.83	44.31	0.16
O2a	Turf ash 1925	5.48	41.64	—
O2b	Turf ash, fallow 1925	6.55	49.79	—
O3a	Grass 1925	6.32	48.03	—
O3b	Grass, fallow 1925	6.40	48.64	—
O7a	Turf 1925	5.90	44.83	—
O7b	Turf, fallow 1925	5.68	43.15	0.35
O5	Rotten grass	4.55	34.57	—
P3	Manured ; Control	5.67	43.08	—
P8	" "	5.95	45.21	—
P2	Steamed tomato haulms	5.31	40.35	—
P4	Hay	5.53	42.02	—
P5	Straw	6.18	46.96	—
P1	Urea	5.41	41.10	—
P7	Grass	5.72	43.46	0.87
P6	Grass, urea and sulphate of potash	6.41	48.71	0.14
Q1a	Unmanured ; Control	2.64	20.05	14.02
Q9b	" "	2.75	20.89	27.62
Q10a	" "	2.20	16.72	15.00
Q2a	Turf ash 1925	2.66	20.22	18.05
Q2b	Turf ash, fallow 1925	3.46	26.28	42.50
Q8a	Grass 1925	2.67	20.28	32.59
Q8b	Grass, fallow 1925	3.43	26.06	28.28
Q6	Fallow 1923 and 1924, cropped 1925 and 1926	3.21	24.40	14.95
Q7	Fallow 1923 and 1925, cropped 1924 and 1926	3.55	26.78	23.38
Q9a	Grass only	3.55	26.98	25.68
Q10b	Base (10 : 5 : 10)	4.94	37.53	6.07
Q1b	Base and grass	4.14	31.46	2.42

B. Cucumber Experiments.

The experiments which were started in 1922 for the purpose of studying the various depressing influences at work in cucumber bases have been continued.

The results were summarised in the Eleventh Annual Report as follows :—

- 1 When the cucumber is grown in a bed of loam and stable manure for one complete season, the bed is rendered unsuitable for cucumber cultivation during the following season.
- 2 By the continuous cultivation of the cucumber in beds placed over the same soil during a number of years, the base becomes contaminated. The actual process is not understood, but it seems reasonable to suppose that the cause of contamination is washed down from the beds and accumulates in the base.
- 3 When the roots of cucumber plants come in contact with the contaminated base their health and fruiting powers are seriously impaired.
- 4 Sterilisation of a contaminated base by means of steam causes a marked improvement in crop and presumably removes the contamination.
- 5 The beneficial effects of steaming last one year only, and therefore it is necessary to steam old soil every year.
- 6 The improvement in the crop from steaming the base is affected by the nature of the weather during the early stages of growth. When the weather is favourable its increased vitality enables the plant to make full use of the sterilised soil. During unfavourable weather, the plants do not make such a good start, and in some cases sterilisation of the base has caused a slight retardation of growth in the early stages.
- 7 It seems advisable to delay steaming the base as long as possible so as to take advantage of planting in warmed soil.
- 8 By spreading and steaming the beds at the end of the season, a higher crop has been obtained under the Experimental Station conditions than by removing the old beds and substituting new compost.
- 9 The substitution for a contaminated base of new soil of a poor gravel nature causes an immediate improvement in crop, and the plants retain their vigour to the end of the season.

- 10 A crop of practically two flats per foot has been obtained over a concrete covered base when the bed was sufficiently big, namely, the previous year's bed spread and steamed.
- 11 The admixture of washed ashes in the beds is an advantage.
- 12 Finally, the cucumber plant requires a well-aerated bed and a well-drained base, if it is to yield the best crop.

During 1926 the results have confirmed the beneficial effect produced by steaming the base or soil upon which the beds are placed. In two plots, D3 and D5, the base was steamed "in situ" and gave 13% crop increase over the untreated control, E3. In two other plots the base was removed to the path, where it was steamed and afterwards returned to its original position. Here a crop increase of 22% over the control was obtained.

In D6 and E2, where the base is covered by concrete, it was decided to compare an old bed steamed against a new big bed. In D6, the 1925 bed was spread and steamed. In E2, the 1925 bed was taken away, the concrete well washed and sterilised with cresylic acid, and a new big bed prepared for the 1926 crop. The crop from both beds was less than that obtained from a steamed base, but the steamed old bed gave as good a crop as the new big bed. This confirms previous results which have indicated that an old bed steamed is equal to a new bed.

In house F, the base of ashes (F1) was compared with an untreated gravel base (F3) and a steamed gravel base (F2). The best results were obtained from the ashes, which showed 11% increase over the control. The gravel base was little better than the control, while the steamed gravel base showed an increase of 8%.

Plots F4 to F8 were made from an old bed used in 1925. This was spread during the winter 1925-26, and divided into five plots, one of which was left untreated (F4), another steamed (F8), while others were treated with cresylic acid (F5), emulsified cresylic acid (F7) and formaldehyde (F6).

The untreated plot F4 produced 1.74 flats per foot. Cresylic acid raised the crop to 1.83 flats per foot (F5), and steam to 2.1 flats per foot (F8). Emulsified cresylic acid (F7) and formaldehyde (F6) were without effect.

In house B, an attempt was made to prove that the inhibiting agent present in old cucumber beds can be washed out by the drainage water. For this purpose an old bed was placed on a raised platform of corrugated asbestos sheets, from which the drainage was collected in a painted tank. The drainage was watered periodically over a steam sterilised bed on the opposite side of the house. As a control, another portion of an old bed

was steamed and placed on a similar platform, with tank for collecting drainage, which was also watered over a sterilised bed on the opposite side of the house.

The results suggest that inhibiting agents present in the old bed were transferred in the drainage water to the sterilised bed opposite. The plot (B2) watered from the old bed produced a crop of 1.62 flats per foot, while that (B1) watered from the steamed old bed gave 1.89 flats per foot. This will be repeated.

In house C an experiment was arranged to compare the value of stable manure and the A.D.C.O. synthetic manure when used in the preparation of cucumber beds. The A.D.C.O. manure was prepared from barley straw and took some three months to make. Throughout the season the plants showed a better type of growth in the A.D.C.O. beds than in those made with stable manure. The total crop showed an increase of 9% in favour of the A.D.C.O. manure. Details of the results are shewn in Table 9.

Table 8.

Showing the composition of the beds and the top dressing treatment employed in the cucumber experiments in houses B, C, D, E and F.

Plots.	Beds.	Top Dressing.	
		First Dressing, March 10th.	*Remaining Dressings, April 2nd, Aug. 24th.
B3, B4, D6, F4, F5, F6, F7, F8.	Beds used in 1925 with 50% stable manure added.	Baked soil and stable manure with 14 lbs. bone meal to every 100 ft. of border.	Baked soil and stable manure with 14 lbs. fertiliser as given in Tomato series G, H and M to every 100 ft. of border.
C2 ...	2 parts baked soil, 1 part A.D.C.O. manure.	As above.	As above.
All other plots.	2 parts baked soil and 1 part stable manure composted in November.	As above.	As above.

* A special top dressing was applied to all plots on June 3rd, July 3rd, August 21st. It consisted of 2 ozs. per sq. yd. of the following mixture: 2 parts sulphate of ammonia, 1 part sulphate of potash, 6 parts superphosphate and 10 parts dried blood.

Table 9.
Cucumber Results.

Plot No.	Treatment.	Pounds per Plant.								Tons per Acre.	Flats per Foot	Relative.
		Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Total.			
C1	Normal Bed	1.40	9.92	9.76	10.39	8.27	7.11	2.30	49.15	73.72	1.48	100
C2	A.D.C.O.	.68	13.32	11.16	11.08	8.03	7.18	2.29	53.74	80.61	1.62	109
D3	Base steamed " in situ "	3.34	15.41	12.32	15.32	10.65	10.74	6.76	74.54	111.81	2.25	116
D5	" " " " " "	2.04	15.02	12.64	13.21	13.15	9.44	5.15	70.65	105.97	2.13	110
D2	Base removed and steamed	4.35	14.07	11.17	14.06	10.12	13.22	7.93	74.92	112.38	2.26	116
D4	" " " " " "	3.79	15.08	13.81	14.09	14.03	12.78	9.08	82.66	123.99	2.49	128
D6	Old Bed steamed over concrete	3.45	13.48	12.29	10.27	8.49	7.76	3.00	58.73	88.09	1.77	91
E2	New Big Bed over concrete	2.87	13.27	12.55	8.89	7.97	9.50	4.30	59.35	89.02	1.79	92
E3	Control	2.99	11.32	12.48	13.01	9.43	10.56	4.45	64.24	96.36	1.94	100
F1	Ashes Base	3.24	11.76	13.18	13.83	11.42	11.00	7.12	71.55	107.32	2.16	111
F2	Gravel Base steamed	2.13	14.44	11.82	11.99	9.40	11.37	8.58	69.73	104.59	2.10	108
F3	" " untreated	2.95	13.53	12.65	12.38	9.25	10.09	5.32	66.17	99.25	1.99	102
F4	Old Bed untreated	3.09	13.71	10.77	11.38	8.19	7.09	3.57	57.80	86.70	1.74	89
F5	" treated with Cresylic Acid	2.72	14.72	12.02	12.02	9.19	7.55	2.72	60.94	91.41	1.83	94
F6	" " Formaldehyde	2.99	13.84	12.50	11.70	8.36	7.81	2.11	59.31	87.96	1.73	89
F7	" " Emulsified Cresylic Acid	4.44	12.50	10.23	10.25	11.49	7.12	1.54	57.57	86.35	1.72	89
F8	" steamed	4.02	15.90	12.18	12.11	8.84	10.18	6.40	69.63	104.44	2.10	108
B1	Watered with drainage from steamed Old Bed	3.15	11.28	14.02	12.83	10.29	8.93	2.30	62.80	94.20	1.89	97
B4	Steamed Old Bed	4.69	12.35	10.72	12.33	9.49	7.71	1.79	59.08	88.62	1.78	92
B2	Watered Old Bed	2.78	11.54	10.66	11.25	8.98	6.80	1.67	53.68	80.52	1.62	83
B3	Watered with drainage from Old Bed	3.76	10.46	8.00	9.96	9.89	7.46	.59	50.12	75.18	1.51	77

C. Soil Sterilisation Experiments.

Through the kindness of Mr. J. Harnett it is possible to publish the further results of his experiments on soil sterilisation.

The first experiment concerned a block of twelve houses, each 250 feet long and 27 feet wide. Previous to the 1925 crop ten were steamed and two left untreated. The latter produced 29½ tons of tomatoes per acre, while the steamed houses gave 51 tons per acre. At the end of 1925, nine of these houses were steamed again, and gave a yield of 50 tons per acre in 1926; two were not steamed again and produced only 39 tons per acre, while the control house, unsteamed for many years, gave 29 tons per acre. This seems to suggest that with the soil in question, and under the conditions operative in 1926, it would have paid to steam the soil two years running.

In a second experiment a block of seven houses were steamed for the 1926 crop, and produced a yield of only 46 tons per acre, but it is interesting to note that this soil has worked into a very fine condition by previous steaming and cultivation, and would obviously be improved by the addition of some binding material such as would be supplied by green manuring. The result tends to confirm the assumption that most nursery soils require green manuring after many years of continuous cultivation and steaming.

A block of eight houses, each 150 feet long and 15 feet wide, were used for a third experiment. These houses had never produced more than 35 tons of tomatoes per acre in spite of the best manurial treatments known. Six houses were steamed and produced 50 tons per acre, while two untreated houses gave only 32 tons per acre.

A fourth experiment was conducted in houses built on old allotment soil, which results shewed to be most suitable for tomato cultivation. These houses were sterilised with cresylic acid for 1922, 1923 and 1924, using the method described in the 10th Annual Report, page 64. During those years the yield never exceeded 40 tons per acre in any house. Previous to 1925 they were steamed, and produced a yield of 50 tons per acre. They were treated with cresylic acid for 1926, and the yield was 45 tons per acre.

These experiments, conducted by a practical man under practical conditions, must be convincing to growers in general. They provide strong evidence in favour of steaming as opposed to the use of cresylic acid, and suggest that after long periods of cultivation the soil reached a state where green manuring or some other form of soil improvement is necessary.

3. Mycological Investigations.

Diseases brought to the station, not previously reported are listed below.

Host.		Disease.		Cause.
Arum	...	Leaf spot	...	<i>Phyllosticta Richardiae</i> .
Aster	...	" Black leg "	...	<i>Phytophthora cryptogea</i> .
"	...	Flower blight	...	<i>Stemphyllium sp.</i>
Carnation	...	Wilt	...	<i>Alternaria sp.</i>
Celery	...	Leaf spot	...	<i>Septoria Apii</i> .
Cucumber	...	Leaf spot	...	<i>Phyllosticta cucurbitacearum</i>
Fig	...	Bronzing of leaves	...	<i>Macrosporium sp.</i>
Gesnera sp.	...	Bacterial leaf spot	...	Organism not identified.
Gladiolus	...	Dry rot	...	<i>Fusarium sp.</i>
Hyacinth	...	Soft rot	...	Bacterial.
Iris	...	Leaf spot	...	<i>Heterosporium gracile</i> .
Raspberry	...	Cane blight	...	<i>Leptosphaeria coniothyrium</i> .
Rose	...	Leaf curl	...	Cause unknown.
Statice latifolia	...	Root rot	...	<i>Ramularia sp.</i>
Tulip	...	—	...	<i>Botrytis narcissicola</i> .
Vine	...	Ædema	...	Physiological cause.

A cucumber disease new to this country, but previously reported in America, was observed in the Lea Valley during May, 1926. Pale yellowish spots and blotches, covered with minute black pycnidia, occurred abundantly on the leaves.

The disease is caused by a fungus, *Phyllosticta cucurbitacearum*, and inoculation experiments indicate that it causes most damage at low temperatures.

The optimum temperature for growth in pure culture proved to be round about 68° F., and no growth occurred at 91° F.

The disease was found in houses where the heating arrangements had been discontinued by reason of the coal shortage. It disappeared when the boilers were re-lighted.

1. *Thielavia* Root Rot of the Tomato.

P. H. WILLIAMS.

The ability of *Thielavia basicola* to attack the tomato was reported last year. Soil inoculations had not then been made, but during the present year plants have been infected by this means. There can be no doubt that the fungus is able to penetrate healthy roots, since seedlings germinated in infected soil become diseased. The fungus attacks the cortical tissue of the root, causing a brown discoloration. On teasing out the root in water, the characteristic club-shaped "winter spores" of the fungus may be seen in the diseased tissue.

Since inoculations in the spring of 1925 had been unsuccessful, temperature was suggested as being the controlling influence. Accordingly plants were inoculated and placed in various positions. Morning and afternoon, maximum and minimum temperatures were recorded. The temperatures shown in the tables are the mean of these readings. The positions chosen for the first experiment were:—

- 1 A chamber in the isolation house.
- 2 The corridor outside the cucumber houses.
- 3 A small portable greenhouse outside.

In 2 the plants were placed in a glass tank to protect them from draughts and accidental injury.

Stem Inoculations.

Four plants were inoculated in each series while two served as controls. Two inoculated plants and one control were examined at the end of a fortnight, and the remainder after four weeks. Three series of plants were killed by frost during December and January in position 3. The lowest average temperature recorded, 41° F., was obtained in position 2 in December, the range being from 28° F. to 53° F. Table 1 shows the total extent of browning produced around the point of inoculation in relation to the average temperature.

Table 1.

Temperature.			Two Weeks.		Four Weeks.	
41° F.	...	...	Very slight	...	Slight.	*
			" "	...	"	*
44° F.	...	...	$\frac{1}{8}$ inch	...	...	—
			$\frac{1}{8}$ "	...	...	—
47° F. to 49° F.	...	...	1 inch	...	...	Slight.
			$\frac{1}{4}$ "	...	...	$\frac{1}{8}$ inch.
54° F. to 56° F.	...	...	$\frac{1}{4}$ inch	...	...	1 inch.
			$\frac{3}{8}$ "	...	...	1 "
58° F. to 59° F.	...	...	$\frac{1}{2}$ inch	...	...	Slight.
			$\frac{1}{2}$ "	...	...	$\frac{3}{8}$ inch.
			1 $\frac{1}{4}$ "	...	...	Very slight.
			$\frac{1}{2}$ "	...	...	$\frac{1}{4}$ inch.
69° F.	...	...	$\frac{1}{2}$ inch	...	...	$\frac{1}{4}$ inch.
			$\frac{1}{2}$ "	...	...	$\frac{1}{4}$ "

* Three weeks only.

The amount of injury increased with increasing temperature in the series examined after a fortnight, although there is one exception at 47°-49° F. The plants allowed to remain for a month before examination, however, show no relation between amount of injury and temperature. It seems reasonable to conclude that *Thielavia* is most active at temperatures above 44° F., and that above this the extent of the disease does not depend entirely upon the temperature.

Soil Inoculations.

Tomato seedlings potted in sterile soil were inoculated by inserting a piece of a pure culture in the soil about 1 inch from the stem. The plants were then placed in the same positions as in the previous experiments.

These experiments again led to the belief that temperature was not the only influence governing the extent of infection. In one experiment the inoculated plants were stunted in comparison with the controls, the roots were brown and poorly developed, and *Thielavia* was present in the tissues. A similar result was obtained at the same time with another set of plants which had been watered with a suspension of spores. The average temperature in these experiments was 54° F. Half of the plants were left undisturbed for a further three weeks, and then there was practically no difference between the inoculated and control plants; the stunted, infected plants having made further growth and caught up with the controls. On examination the roots were found to be brown at the base only while the newer roots were free from attack. During the time between the first and second examinations a period of dull weather had ended, and the average temperature had risen to 62° F. This was reflected in the increased growth of the plants.

The results of these experiments suggested that when conditions are such that growth is slow, the fungus attack may be severe and death follow. On the other hand, if conditions are favourable for rapid growth, the plant is able to stave off the disease since infection does not keep pace with the production and growth of new roots.

In another experiment, three sets of six plants each were inoculated and placed in various positions:—

A.—A cucumber chamber.

B.—A tomato chamber.

C.—Out of doors, but protected from rain.

The procedure outlined above was followed and the results are summarised in Table 2.

Table 2.

	Average Temperature.	Dry Matter.	Healthy.	Slightly Diseased.	Badly Diseased.
A.	79.9° F.	6.14 gms.	1	2	3
B.	71.3° F.	5.71 gms.	—	2	4
C.	65.7° F.	4.70 gms.	—	—	6

These results suggest that the amount of disease is more or less dependent on the rate of growth.

Temperature Relations of the Fungus.

Pure culture work not finished in time for the Eleventh Annual Report included the growth of the fungus at different temperatures. The fungus was grown on potato agar, and Table 3 shews the amount of growth after 10 days at the temperature cited.

Table 3.

Temperature.	Amount of Growth, Av. Diam. of Colony.
50° F.	1.8 cms.
59° F.	3.5 cms.
68° F.	5.9 cms.
77° F.	7.1 cms.
86° F.	6.1 cms.
95° F.	1.0 cm.
Minimum temperature—below 41° F.	
Maximum " about 99° F.	
Optimum " 77° F.	

At 95° F. the growth consists principally of the club-shaped winter spores, and at lower temperatures these are only produced as the culture ages.

Conclusions.

- 1 *Thielavia basicola* is a weak parasite of the tomato.
- 2 The intensity of the disease varies with the rate of growth of the plant. Slow growing plants may be badly diseased, but an increase in the rate of growth enables the plant to resist the fungus attack.
- 3 Infection is slight below 48° F. Above this it is not entirely governed by the temperature.
- 4 Any circumstance which checks the development of the plant and causes a retardation in the rate of growth, renders it susceptible to attack by *Thielavia basicola*.

2. "Damping-off" of Tomatoes and Cucumbers

P. H. WILLIAMS.

In the previous report a short account was given of a fungus resembling *Phytophthora*, isolated from cucumber seedlings which had "damped off." It was stated that this fungus readily attacked cucumber seedlings, but did not touch tomato seedlings or pot plants of tomatoes and cucumbers.

The investigation has been continued during the present year, and while tomato seedlings were never infected by the fungus at any time, it was found that pot plants of both tomatoes and cucumbers could be infected at certain periods of the year and not at others. The first infection period occurred in March, and the second during June and July. Cucumbers potted up in diseased soil "damped off" in three days, while plants inoculated by pricking a piece of the fungus into the stem fell over in less than 17 hours. At other times of the year, however, a slight browning of the pith was the only effect of the inoculation.

Table 1 shows the result of a series of inoculations from the time pathogenicity to pot plants was first established until the end of the second period of activity.

Table 1.

Date of Inoculation.	No. of Plants.	Experiment Ended.	Average Temp. ° F.	Result.
8/3/26	6 Cucumber	12/3/26	72.3	All killed
10/3/26	3 "	"	76.0	"
"	3 "	11/3/26	72.2	"
19/3/26	12 "	25/3/26	72.9	11 killed
"	12 Tomato	"	67.2	1 " }
12/4/26	6 Cucumber	7/5/26	74.3	1 " } infected soil
"	6 "	"	68.5	Healthy
"	6 "	"	58.8	1 killed
"	6 Tomato	"	74.3	Healthy
"	6 "	"	68.5	"
"	6 "	"	58.8	"
25/5/26	6 Tomato	18/6/26	83.5	Healthy
"	6 "	"	79.4	"
"	6 "	"	70.1	"
14/6/26	12 "	28/6/26	73.7	7 killed
17/6/26	18 "	"	74.0	12 "
1/7/26	6 "	3/7/26	82.4	6 "
7/7/26	6 Cucumber	9/8/26	82.6	2 "
"	6 "	"	73.5	5 "
"	6 Tomato	"	73.5	3 "
16/7/26	6 Cucumber	"	80.0	Healthy
"	6 "	"	72.4	"
"	6 Tomato	"	84.6	4 killed
"	6 "	"	74.0	4 "
29/7/26	12 "	"	75.2	10 "

The failure of inoculations in 1925 was at first ascribed to unfavourable temperature conditions, and therefore, records were kept throughout the season. Table 2 gives the relation of temperature to the fungus attack.

No infection took place below an average temperature of 70° F.

Data are lacking as to the temperature in the latter part of 1925, so that it is impossible to say whether the failure of the inoculations then was due to the low temperature. Above 70° F. the degree of infection does not appear to be connected entirely with temperature. Some other influence is at work, but so far it remains undetermined.

The Inoculation of Tomato Fruits.

Fruits on the growing plant were inoculated by inserting a piece of mycelium into the blossom end. A brown water-soaked area was formed round the point of inoculation, extending deeply

into the fruit. No zoning was observed, but a similar appearance was produced by *Phytophthora parasitica* isolated from a tomato fruit.

Table 2.
Influence of Temperature on Infection.

Temperature ° F.	Cucumbers.	Tomatoes.
58.8	—	—
68.5	—	—
70.1	°	—
72.2	+	°
72.3	+	°
72.4	—	°
72.9	+	+
73.5	+	+
73.7	°	+
74.0	°	+
74.3	+	—
75.2	°	+
76.0	+	°
79.4	°	—
80.0	—	°
82.6	—	°
83.5	°	—
84.6	°	+

+ = positive inoculation result.

— = negative.

° = no experiment.

Growth of the Fungus.

The fungus grows very rapidly, and has a relatively high optimum temperature. The following table shews the effect of temperature on growth.

Table 3.
Showing Diameter of Colonies in Centimetres.

Temperature.	Number of Hours after Inoculation.						
	12	16	24	30	36	48	60
53° F. to 55° F.	—	—	—	—	1.9	3.1	6.2
60° F. ...	—	—	1.0	—	3.0	5.3	×
77° F. ...	2.7	4.3	6.6	8.4	8.8	×	×
86° F. ...	3.9	—	7.8	—	8.9	×	×
95° F. ...	4.6	6.5	8.8	10.7	×	×	×
104° F. ...	3.9	—	7.2	—	8.2	×	×
109° F. ...	—	1.5	—	1.7	—	1.8	—

× = plate full,

Type of Growth at Different Temperatures.

53-55° F.	Growth thin, chiefly in the medium.
60° F.	" " " "
77° F.	Aerial mycelium good.
86° F.	" " " "
95° F.	" " " "
104° F.	Growth in medium only.
109° F.	" " " "
113° F.	No growth.

It will be seen that the minimum, optimum and maximum temperatures approximate to 45° F., 95° F. and 112° F.

3. Bacterial Rot of Hyacinth.

P. H. WILLIAMS.

Diseased hyacinth bulbs received for examination showed a brownish rot extending into the scales from the basal plate. Bacteria were abundant in the diseased tissue, and in extreme cases the whole bulb was converted into a soft, evil-smelling mass.

A bacillus was isolated which produced a characteristic rot when pricked into pieces of healthy hyacinth scale, and preliminary tests upon different vegetables showed that its action was similar to that of *Bacillus carotovorus*, which it also resembled in culture. Accordingly parallel cultures and inoculations were made, the results of which are detailed below.

Inoculations.

Hyacinth.

The outer scales were removed from healthy bulbs, which were then inoculated by pricking into them pure cultures of the hyacinth organism and also *Bacillus carotovorus*. In both cases an extensive brownish rot was produced in six days, the controls remaining healthy.

Vegetables.

Whole vegetables were thoroughly scrubbed and inoculated with the bacteria. The results after 11 days are shown in Table I.

In view of these results there can be little doubt that the disease is caused by a strain of *Bacillus carotovorus*. Further experiments on the infection of bulbs under natural conditions is now in progress.

Table 1.
Inoculations in Vegetables.

Vegetable.	Hyacinth Organism.			Bacillus carotovorus.
Celery	Rapid rot	...	...	Rapid rot.
Parsnip	Rot	...	...	Slight rot.
Carrot	"	...	...	Rot.
Turnip	"	...	...	"
Swede	"	...	...	"
Beet	No rot	...	...	No rot.
Potato	"	...	...	"
Onion	Slight rot	...	...	Slight rot.]
Cabbage	Rot	...	...	Rot.

4. Soft Rot of the Arum.

W. F. BEWLEY AND P. H. WILLIAMS.

Measures for controlling this disease were recommended in the Seventh Annual Report, page 39, and since that time they have been used on a large scale on commercial nurseries. They consist of mechanically cleaning the infected corms with water, using a stiff brush and some blunt instrument for removing the diseased areas, and then steeping in a solution of formaldehyde (1 part 40% formaldehyde in 49 parts water) for from one to four hours, in accordance with the degree of infection. Treated corms are then repotted in sterilised soil placed in sterilised pots.

While these means have proved effective in most cases, there have been occasional reports of damage to either small or badly infected corms, and an alternative method of steeping the corms in a solution of mercuric chloride has been investigated. It has been found that infected corms can be cleaned by steeping in a solution of this compound for seven hours and there is little risk of damaging the corms.

The revised treatment, which should be applied at the end of a dormant period is as follows :—

1. Shake the plants out of the dry soil and remove all roots close to the corm.
2. Wash in water, using a stiff scrubbing brush and a blunt piece of wood to remove the decayed portions of the corm.
3. Steep the corms in mercuric chloride solution at the rate of 1 ounce of mercuric chloride to 6 gallons of water for seven hours,

4. Re-pot in sterilised soil using pots sterilised by boiling in water or by steam.
5. Place the pots in houses which have been thoroughly disinfected by spraying the floor and superstructure with cresylic acid (1 gallon, 97-99% cresylic acid, in 39 gallons water).

It must be remembered that mercuric chloride is very poisonous to animals and man. Mercury salts are not easily eliminated from the human body, and if successive small doses are taken they accumulate in the system, until the amount present is sufficient to produce poisonous effects and cause death.

Preliminary experiments have been undertaken in which diseased plants were watered with various solutions in an attempt to control the disease without injuring the plants; and while promising results have been obtained, it is too early to suggest control measures.

5. Tomato Mildew.

I. C. JAGGER.

Tomatoes were tested for resistance to "mildew" (*Cladosporium fulvum*, Cke.) by inoculating small plants in seed boxes and 3-inch pots. Inoculations were made by thoroughly atomizing the plants with a heavy suspension of spores in water, after which the plants were kept in a glass chamber with humidity near the saturation point for approximately 60 hours to insure spore germination and infection. Spores scraped from "mildewed" tomato leaves were used, the fungus from pure culture being unsatisfactory for extensive inoculations on account of limited sporulation. Very heavy infection was obtained on all leaves including the cotyledon leaves of inoculated plants. The incubation period varied from approximately 10 days under very favourable conditions in June to 25 days or more in December.

Ninety-six varieties of tomatoes were tested and all found susceptible to *Cladosporium fulvum*. The varieties Sterling Castle, Up-to-date and Norduke, however, showed some resistance. On these varieties the "mildewed" spots were smaller, and the fungus sporulated later and less abundantly than on the more susceptible varieties.

Whether this resistance is sufficient to be of any commercial importance can be determined only by further test on a commercial scale. Sterling Castle and Up-to-date are English glass-house varieties. Norduke, which seemed most resistant of all, is a large fruited American variety with small trusses.

6. Lettuce Mildew—(*Bremia Lactucae*, Reg.),

I. C. JAGGER.

Being interested in developing improved mildew (*Bremia Lactucae* Reg.) resistant varieties of lettuce, the writer brought to England seed of four varieties, which had repeatedly proved entirely immune in U.S.A. Inoculated at Cheshunt with *B. Lactucae*, collected in the vicinity of London, these varieties have all repeatedly developed mildew rather abundantly. This suggests that the *B. Lactucae* of lettuce in England is probably a different physiological strain from that in U.S.A.

Sweitzer* has shown that in Switzerland *B. Lactucae* is made up of several physiological or specialised strains, each strain being confined to closely related host species belonging to a single genus.

At Cheshunt the fungus occurs commonly on weeds belonging to the genera *Senecio*, *Sonchus* and *Cirsium* as well as on *Lactuca* (lettuce). Cross inoculation experiments showed that there are four distinct physiological strains of the fungus on these four genera at Cheshunt. In other words, lettuce is not infected by mildew from the common weeds of the genera *Senecio*, *Sonchus* and *Cirsium*, although the mildew which occurs commonly on those genera is indistinguishable microscopically from that on lettuce.

In testing 68 varieties of lettuce, a single variety was found which has repeatedly shown itself highly resistant or possibly immune at Cheshunt to *B. Lactucae*, collected in the vicinity of London.

This resistant variety was obtained from Vilmorin-Andrieux & Co., Paris, under the French name "Laitue passion blanche à grosse" or "Laitue de Saint-Ilan."

7. *Rhizoctonia* "Foot-Rot" of the Tomato.

T. SMALL.

Winter Treatment of Infected Nurseries.

In concluding this investigation attention has been focussed on soil sterilisation. It is obvious from observations on nurseries and experiments made in the course of this work that the fungus overwinters in the soil, and therefore on infected nurseries it is necessary to sterilise the soil at the end of the season. Steaming or baking, as reported last year, have given freedom from this disease, but, as they are not always possible, certain chemical

* Sweitzer, J. Die kleinen Arten bei *Bremia Lactucae* Regel und ihre Abhängigkeit von Milieu-Einflüssen. Verh. d. thurgauisch. naturforsch. Gesellsch. Heft 23, 1919.

compounds which had given promising results in preliminary experiments have been re-tested. The results are shown in Table 1, and when it is remembered that the experiments were carried out carefully and on a small scale, it seems reasonable to conclude that control by these fungicides is less reliable than steaming and is indeed rarely possible under nursery conditions. Some of the compounds however are now being tested on a large scale.

Table 1.

Compound.	Percentage in Soil.	No. of Plants.	No. Infected.
Formaldehyde	0.250	10	3
Phenol	0.220	10	0
Potassium dichlorcresylate* ...	0.032	10	2
Potassium dichlorphenate* ...	0.065	15	3
Ammonium carbonate	0.880	15	4

* Viable sclerotia were found on the sides of some pots containing healthy plants.

Incidentally these experiments showed that the fungus can resist desiccation, for during the interval between treating and planting the soil became very dry but the fungus remained quite active. Dry sclerotia remained viable for eight weeks at 95° F.; longer periods were not tested.

Summer Treatment of Infected Nurseries.

An attempt was made to find a fungicide which would enable the grower to replant the infected area at once. Solutions of the following compounds were tested, using 100 ccs. of a strength which just failed to kill the plants: "Cheshunt compound," copper sulphate, sulphuric acid, formaldehyde, uspulun, ammonium polysulphide, ammonium hydroxide, ammonium carbonate, ammonium sulphate, ammonium chloride, and ammonium nitrate. Only uspulun appeared to have any effect upon the disease, and in a final test with this fungicide using a 0.25 per cent. solution in sufficient quantity to saturate the soil, thirteen out of sixteen plants escaped infection while all the controls were severely diseased.

Artificial Fertilisers.

Further work was necessary to confirm the suggestion that less disease resulted when ammonium sulphate was applied as a top dressing. Although the results, shown in Table 2, are

not conclusive there is a slight indication that this fertiliser reduces the amount of disease and further trials are being made on a larger scale.

Table 2.

Fertiliser.	Percent, in Soil.	No. of Plants.	Degree of Infection.		
			None.	Fair.	Bad.
Ammonium sulphate	None	38	2	16	20
" "	0.5	38	14	16	8
Complete artificials* ...	None	10	—	1	9
" "	1.5	10	5	4	1
" " less potash	1.0	10	2	5	3
" " less nitrogen	1.0	10	—	1	9
" " less phosphate	1.0	10	3	6	1

* Complete artificials includes potassium sulphate, superphosphate, and ammonium sulphate

Control Methods.

As a result of this investigation the following methods of control may be suggested :—

1. Diseased plants and the soil immediately surrounding them should be removed, care being taken to ensure that no soil is transferred from the diseased area to other parts of the house, and the hole thus made should be treated with a 0.25 per cent. solution of uspulun. The diseased area may then be re-planted and the plants given a top dressing of ammonium sulphate.
2. Dry aerated soil conditions should be maintained by periodic hoeing of the surface soil and, if possible, by reducing the water supply and raising the temperature.
3. After uprooting and removing the plants at the end of the season the soil should be steamed. This must be done thoroughly for experiments have shown that the fungus spreads much more rapidly in steamed than in non-steamed soil so that if during steaming any portion remains untreated the fungus will soon spread through the soil.
4. Weeds in and about the houses should be destroyed as these may serve as hosts in the absence of tomato plants.

8. A Disease of the Strawberry.

T. SMALL.

Since 1925, when this disease was first described, a considerable number of diseased strawberry plants have been examined. Repeated isolations and the inoculation of healthy plants have shown that *Diplodina lycopersici* is the causal organism.

The Fungus.

Growth occurred on a synthetic medium between 54.5° F. and 82.4° F. being most rapid between 72.5° F. and 77.0° F. No growth resulted at 86.0° F.

Germination of the Spores.

The optimum temperature for spore germination was determined by placing spores on slides smeared with agar medium because germination in hanging drops was irregular. Germination occurred between 51.8° F. and 82.4° F., being quickest between 68.0° F. and 77.0° F. At 72.5° F. spores germinated in six hours in distilled or tap water.

When sterile strawberry leaves, soil, straw or stable manure were inoculated with spores a good fungal growth resulted, which suggests that the disease may be spread in this way.

Inoculation Experiments.

Strawberry plants, variety Royal Sovereign, were used and when the fungus was introduced through a wound the usual precautions to guard against secondary infection were taken. The experiments may be divided into the following groups :—

- (a) Inoculation under artificial conditions.
- (b) Inoculation under natural conditions.

(a) Inoculation under Artificial Conditions.

Eight petioles were inoculated by pricking the fungus into the tissues and after seven days in a moist chamber all of them were infected while the controls remained healthy. Similar results were obtained by inoculating roots and runners. Pycnidia developed in the diseased tissues and re-isolations yielded a fungus identical with the original. Pieces of mycelium were placed in contact with petioles, roots, and both surfaces of leaves and petals, to see if infection could occur in the absence of wounds. After six days in a moist chamber at an average temperature of 60.0° F., infection occurred in all cases except a few petioles. Leaves,

contained in moist dishes, were atomised on the lower or upper surface with a suspension of spores either in water or nutrient medium. With a few exceptions infection of either leaf surface only occurred where nutrient medium was used. Germinating spores attached to agar medium were transferred to leaves contained in moist dishes and after four days infection of both surfaces had occurred.

(b) Inoculation under Natural Conditions.

Plants placed in diseased soil at intervals between May and August remained healthy but those used in September became infected. When plants, in a moist chamber, were atomised with a suspension of spores in water, the stipules and petals only were infected. This suggests that infection usually takes place from the soil and is favoured by fairly low temperatures. It is hoped to continue these experiments next year.

Experiments with *Rhizoctonia*.

During this investigation a strain of *R. solani* was isolated from diseased strawberry plants. Stab inoculations into the base of healthy roots showed that the fungus is parasitic on the strawberry.

9. "Root-rot" of the Cucumber.

A. P. WILSON.

The life of a cucumber plant growing under commercial conditions is frequently shortened by premature decay of the roots. Longitudinal splitting, rotting of the softer tissues and blackening of the vascular bundles are common features, and the causes affecting these conditions have long required investigation.

As the work was not commenced until November, 1925, it was not possible to obtain freshly dug roots, so the examination was confined to bundles of dry roots taken from the various plots in the experimental houses.

The 1926 crop was treated somewhat differently. Every plant which wilted or died was dug up, care being taken to get the root up as cleanly as possible and to collect all the small roots which broke away from the tap root in the process. Notes were taken of the condition of these roots and the plots to which they belonged. Isolations were made whenever possible. At the end of the 1926 season those plants which were still alive were carefully dug up and their condition noted.

An examination of the roots of the 1925 crop showed :—

1. A marked difference in the amount of root rot in the different plots.
2. That a large number of organisms were concerned with the decay.

An examination of the 1926 crop confirmed this. An effort was made to correlate the extent of root injury with the physical and manurial conditions prevailing in the bed, and to isolate as many organisms as possible in the hope of finding the causal organism or organisms by inoculation.

Healthy Roots.

The healthy roots possessed tap roots some 8 to 12 inches long. The tap root was rectangular and tapered to the tip, which ended in a rootlet usually inclined at an angle to the main root. A great number of lateral roots were present, the largest being those nearest the soil level. The tap root and the wilted roots were white or cream coloured and hard, both internally and externally. The stem immediately above the soil level was hard, without any fungal growth on its exterior, although it was frequently covered with green algae, which did not appear to have any detrimental effect. When cut longitudinally the stem showed clean healthy tissue of a greenish colour.

Diseased Roots.

The rotted roots showed various degrees of injury from those which had a good root system but showed splitting, browning and softening of the tip of the tap root and a slight black spotting of some of the small lateral roots, to those in which the original tap root had rotted away and the few lateral roots produced from the nodes of the stem where it had been earthed up, showed rotting of the softer tissues and blackening of the wood.

Infected laterals with the cortical tissue intact were either covered with tiny black spots on the surface due to masses of black carbonised hyphae (*Claderrhinum*) or showed black globose bodies under the cortex, raising it and giving the appearance of large black spots (*Haplosporium*).

Infected laterals from which the cortical tissues had rotted away showed black stains on the wood bundles. The wood bundles of the tap root showed the black stain and also parts of the surface were covered with a black papery substance. When cut across or longitudinally to the centre of the root they presented a brown and water-soaked appearance and the vessels were brown. The stem was soft and a white fungus growth was frequently visible on the outside. The vascular bundles and the stems were brown,

The Extent of Root Injury.

An attempt to correlate the extent of root injury with the conditions prevailing to the bed and the yield of crop is summarised in Table 1 for the 1926 crop. The percentage of sound roots is represented by crosses. It will be seen that plants growing in beds over either a steamed or ashes base have the healthiest roots.

Table 1.
Cucumber Roots, 1926.

Proportion of Sound Roots shown thus :—

0%— 10% ... x.
10%— 20% ... xx.
90%—100% ... xx. xx. xx. xx. xx.

Plot.	No. of Plants.	Treatment.	Percentage Sound Plants.	Crop Flats per ft.
C1	36	Normal bed, steamed base ...	xx. xx. ...	1.48
C2	36	A.D.C.O.	xx. xx. ...	1.62
D2	9	Base removed and steamed...	xx. xx. xx. xx.	2.26
D3	9	Base steamed " in situ " ...	xx. xx. xx. xx.	2.25
D4	9	Base removed and steamed ...	xx. xx. ...	2.49
D5	9	Base steamed " in situ " ...	x. (eelworm) ...	2.13
D6	36	Old bed steamed on concrete	xx.	1.77
E2	36	Big bed over concrete ...	xx. x.	1.79
E3	36	Control	xx. x.	1.94
F1	12	Ashes base	xx.xx.xx.xx.xx.	2.16
F2	18	Gravel base steamed ...	xx. xx. xx. x....	2.10
F3	18	Gravel base unheated ...	xx. xx. x. ...	1.99
F4	9	Old bed unheated	xx.	1.74
F5	10	Old bed cresylic acid ...	x.	1.83
F6	10	Old bed formaldehyde ...	xx.	1.73
F7	10	Old bed emulsified cresylic ...	x.	1.72
F8	9	Old bed steamed	xx. xx. xx. ...	2.10

Fauna.

The examination of the roots showed that a considerable number of small animals were present, among which woodlice, millipedes, worms and mites were plentiful. These animals seem to use the split roots as hiding places and are not considered to be responsible for the rot in the first place. No animals were found in healthy roots. It was noted, however, that where a large mass of worms were found inside a hollow decayed root the surfaces of the wood bundles surrounding the hollow were thickly covered with the black papery substance,

Isolations.

The following organisms were isolated from diseased tissues :—

Fungi—*Fusarium* sp.

Phytophthora sp.

Tricothecium sp.

An Ascomycete in the perithecial stage.

A Fungus having carbonised hyphae.

Bacteria—An orange Bacillus.

A creamy viscous Bacillus.

A cream coloured Bacillus showing dendritic growth.

Fusarium sp. was isolated from the stems and main root of diseased plants. The stems frequently showed a white fungal growth on the outside. The characteristic sickle shaped conidia were rarely found. Microconidia were produced in abundance.

Phytophthora sp. was isolated from three plants in House B. *Tricothecium* sp. appeared in the fruiting stage all over the outside of the roots the day after they had been pulled up. The colourless conidia were extremely abundant, the conidiophores growing out erect from the surface of the wood. This may have been a secondary infection but it appeared with great regularity on the roots.

An Ascomycete in the perithecial stage. This was found in abundance on the majority of the lateral roots of the plants in all the plots except F4, F6, F7, F8, in the 1926 crop. The perithecia were found chiefly on the small roots but occasionally on large laterals. They were situated under the cortex with the beak protruding through it. They were large, globose and black, with a distinct ostiole. The perithecia contained numerous asci, each of which produced a single smooth, brown or black ascospore. The young ascospore was brown, becoming black at maturity. The presence of these perithecia under the cortex tended to loosen it, and it was easily stripped off, taking with it the perithecia attached by their beaks. This suggested an explanation why no trace of these perithecia had been found in the 1925 crop. In pulling the roots out of the soil the small roots had been broken off, and in those which remained attached to the tap root the cortex and perithecia had been stripped off and left in the soil lumps. This suggestion received support when the 1926 crop was lifted. Small roots were pulled out of lumps of soil and if they came out stripped of their cortex the lumps were broken open revealing pieces of cortex with perithecia. All efforts to germinate the ascospores have so far failed and at present the fungus has not been obtained in culture. It has not been fully identified, but Miss Wakefield, who kindly examined some perithecia, suggested that it might be a species of *Haplosporium* (Montague).

A fungus with carbonised hyphae was isolated from the black stained areas in the diseased roots. On ordinary laboratory media it produced long single or interwoven strands of carbonised hyphae, which were also found on the sides of the test tube. Sometimes a black shiny layer was formed under the surface of the medium. On agar slopes the carbonised hyphae were produced round the streak and to a depth of about $1\frac{1}{2}$ mm. in the medium. Under certain conditions tiny white or greyish spore clusters were formed on the surface of the slope or plate. These spores were very small, round, and of a pale greenish colour. All attempts to germinate them have failed.

Experiments on the rate of growth and spore production at different temperatures are given below, Table 2.

Table 2.

Temperature.	No. of Days to cover a 3.6" Plate.	Day Carbonised Hyphae appeared.	Day Spore Masses appeared.	Remarks.
59° F.	7 days	None	None	Poor growth. Slow.
77° F.	4 "	5th	6th	Spores abundant. Good growth.
86° F.	2 "	3rd	5th	Good growth. Spores fairly abundant.
92° F.	2 "	4th	6th	Good growth. Spores fewer.
104° F.	3 "	None	None	Very scanty growth.
110° F.	No growth.	None	None	—

The optimum temperature for growth is relatively high (86° F. to 92° F.) but maximum spore production is obtained at about 77° F.

This fungus has not been fully identified but Miss Wakefield suggested that it might be a species of *Claderrhinum*, possibly *C. foecundissimum* (Sacc. and March).

Bacteria.

None of the bacteria have yet been identified. They were isolated from brown vascular bundles in the diseased roots.

Inoculation Experiments.

Stab inoculations were made with small pieces of a pure culture of the different fungi. Cucumber plants of all ages in pots were used.

Fusarium Sp.

No infection was obtained so long as the stems were perfectly healthy. If the roots were killed with boiling water before inoculation a browning of the vascular bundles of the stem and root was visible. Isolations from these brown bundles produced chiefly bacteria, notably one of a light brown colour. On two occasions *Fusarium* was re-isolated.

Phytophthora Sp.

Very little inoculation work was done with this fungus. No infection was obtained with relatively old plants, but there was an indication that this species of *Phytophthora* is identical with that which sometimes causes damping off of cucumber seedlings and young pot plants.

Trichothecium Sp.

No inoculation work was done with this fungus.

Ascomycete, Perithecial stage.

Healthy pieces of root, sterilised on the outside, were inoculated with ascospores and pieces of cortex containing perithecia. No infection was obtained. The ascospores showed no inclination to germinate and soaking them in dilute Hydrochloric acid had no effect.

Fungus with Carbonised Hyphae.

Pieces of medium containing the pure culture of carbonised hyphae were used for inoculations.

Inoculation.					Result.
Roots of young plants growing in pots	...				No infection.
" older " " "	...				"
Soil round young " " "	...				"
" older " " "	...				"
Pieces of young roots killed by boiling	...				Vascular bundles black with carbonised hyphae.
Pieces of young roots sterilised with mercuric chloride.					Black spotting on cortex. Spores produced later.
Pieces of old roots killed by boiling ...	...				No infection.
Pieces of old roots sterilised with mercuric chloride.					"
Seedlings grown in flask on infected medium					Roots gradually became filled with carbonised hyphae.

Controls in all cases showed no infection.

No infection was obtained with living plants in pots, which seemed to indicate that the right conditions for infection in the field have not yet been worked out. When cut, the infected roots

showed that the black spots on the cortex and the black strands in the vascular system were composed of masses of carbonised hyphae. The infected roots were aseptically transferred to an agar slope and the characteristic carbonised hyphae appeared in the medium. Tiny tufts of greyish spores were visible.

In the field, the tiny black spots on the small roots, when examined under the microscope appeared to be composed of carbonised hyphae similar to those found in culture. The spots, however, were flat in the cortex while those on the inoculated roots showed a tendency to be slightly raised.

Bacteria.

No inoculation experiments were performed with the bacteria.

Conclusions.

- (1) The results of this preliminary investigation indicate that the fungus with carbonised hyphae is the most promising of the organisms isolated.
- (2) Much inoculation work remains to be done and the right conditions for infection in the field have yet to be investigated.

Acknowledgments are due to the Ministry of Agriculture and Fisheries for the scholarship which enabled the writer to spend an extremely interesting year at the Cheshunt Experimental Station, during which time this work was carried out.

The investigation of this problem was undertaken at the suggestion and under the direction of Dr. W. F. Bewley, to whom the writer is indebted for valuable advice and encouragement. Thanks are due to Miss Wakefield for her kindness in examining cultures, and to the laboratory and glasshouse staffs of the Research Station for their unfailing help and co-operation.

Summary.

- 1 The premature decay of cucumber roots under commercial conditions has been investigated.
- 2 The following organisms have been isolated :—
 - (a) *Fusarium* sp.
 - (b) *Phytophthora* sp.
 - (c) *Trichothecium* sp.
 - (d) An Ascomycete in the perithecial stage with a monosporous ascus.
 - (e) A fungus having carbonised hyphae.
 - (f) Three bacteria.

- 3 The most important organism appears to be the fungus which produces carbonised hyphae, although no positive results were obtained by inoculating healthy plants with any of the organisms isolated.
- 4 Sterilised roots and seedlings in flasks were readily infected with the above fungus, and experiments suggest that cucumber roots are first weakened by conditions in the bed prior to infection by the organism concerned.
- 5 The fungus with carbonised hyphae thrives at a relatively high temperature, having optimum spore production at 77° F.
- 6 Plants in beds over either a steamed base or an ashes base shewed the healthiest roots.

4. Entomological Report.

1. Red Spider (*Tetranychus telarius*, L.).

E. R. SPEYER.

Notes on the Life History.

In the account of the life-history and habits of Red Spider, given in the Annual Report for 1925 (pp. 89-93), some points required further investigation.

The chief of these was the curious habit of "rope making and cocoon spinning" in cucumber houses. Cocoons and portions of ropes were collected at the end of September, 1925, and kept over the winter in glass tubes under both dry and moist conditions. At the end of February, 1926, they were removed from the tubes, and placed on the foliage of cucumber pot-plants, red hibernating forms of spider being used as controls on other plants similarly grown. In no case did the spider from the cocoons and ropes cause any infection, whilst the normal hibernating forms, in every instance, initiated a severe attack. The spider in the cocoons and ropes were, in fact, all dead.

During May, spider were induced to spin cocoons by withholding water as much as possible from the plants used as controls in the previous experiment. These cocoons were removed to fresh uninfected plants and kept under observation for a period of three weeks. It came to light that the spider gradually made their way out through the loose silken covering, escaping singly or in twos and threes, until the cocoons were empty. It is, therefore, concluded that this peculiar habit is an adaptation of the spider to its environment, and has nothing to do with hibernation. When the food supply becomes exhausted from the plant

upon which the spider has been multiplying, the cocoons and ropes serve as a temporary resting place until the plants can put out fresh foliage, and the reason for a comparatively small number of spider in various stages of development adopting this habit is thus explained. Those which fall from the webs during the spinning of a cocoon wander away in search of other plants which will afford suitable sustenance.

With a view to collecting more information upon the hibernating habits of spider, ventilator fittings were removed in November from tomato houses which had been severely infested during the season of 1925. On the inside of these fittings were many thousands of red adult spider, but only a small proportion of them were alive. When kept in a dry place death ensued rapidly, and it was only by placing them in boxes surrounded by moist earth and closing in the whole to prevent desiccation that the spider were kept alive until the following spring.

Towards the end of February, these spider were placed upon the foliage of cucumber and "Kondine Red" tomato plants in pots. On both the spider began to feed almost at once, and on the cucumbers numerous eggs were laid three to four days after, but on the tomato plants few eggs were deposited, and not until seven days after the plants were infected. The red pigment of the female spider disappeared gradually, but persisted for 14 days. By the middle of March the cucumber plants were heavily infested with the descendants of these over-wintering forms, while the infestation was extremely slight on the tomato plants. This is remarkable, as these hibernating spider must have fed upon tomato foliage during the previous season. Through the winter months, red spider were bred continuously, but in small numbers on tomato and carnation plants in a heated glasshouse. These produced several generations in which both red and black forms were present. Red forms from the tomato plants were transferred to cucumber pot-plants at the end of February, and these neither laid eggs nor lost their colour up to the middle of March. Black forms from the same source, on the other hand, bred very freely on cucumber plants, and produced only black forms during March. Red forms from carnation plants transferred to tomato plants in February laid a few eggs, but by the middle of March, no spider could be found on the foliage. Others transferred to cucumber plants laid numerous eggs, and only black forms appeared in the successive generations.

These observations incline to the following conclusions :—

- 1 Early in the season the tomato plant is not a favourable host to spiders which have over-wintered.

- 2 The duration of the hibernating period is not curtailed by the advent of favourable conditions, nor is it entirely prevented by such conditions. This lends weight to the contention that all spider do not come out of hibernation at one and the same time.
- 3 Hibernation is not essential to the survival of red spider, which can breed on a variety of plants during the winter under favourable conditions and can continue, without the production of red forms, to breed on cucumber plants in the spring.
- 4 All adult spider on carnation plants tend to exhibit a red colouration which precludes the separation of the hibernating from the summer forms. On tomato plants the distinction is more marked, but not so much as on cucumbers.

Collections of straw from infected tomato houses made during October, 1925, and placed round tomato pot-plants in January, 1926, gave no infection, but this straw was kept in a dry place and the spider were killed under these conditions, as a certain amount of moisture is essential for their survival.

Fumigation Experiments.

Numerous volatile compounds have again been tested with a view to obtaining a fumigant which will control red spider under conditions which prevail in tomato houses. These included especially, derivatives of and compounds related to naphthalene—namely, the hydro-, methyl-, nitro-, chlor-naphthalenes and naphthylamines, acenaphthene, and distillates from Anthracene oil.

Further experiments were also made with Pyridine, Xylene, Toluene and Epichlorhydrin. No definite results were obtained with any of them and the naphthalene derivatives were particularly harmful to plant-life.

An apparatus was set up to draw vapours of various compounds mixed with air over red-spider living upon foliage, with the object of standardising the action of different substances.

In the following table, only the approximate percentages of mortality are given :—

Table 1.

Compound.	Duration of Exposure.	Difference in weight before and after Exposure.	Temperature during Exposure.	Action on Red Spider.
Naphthalene	5 hours	0.212 gms.	60° F.	Temporary
"	7 "	0.057 "	58°-65° F.	"
"	14 "	0.065 "	62°-66° F.	50% killed
"	14 "	0.685 "	60°-66° F.	50% "
"	24 "	0.160 "	56°-66° F.	75% "
Ammonia(.880)	100 mins.	4.51 "	55°-58° F.	100% "
Pyridine (pure)	20 "	0.44 "	58°-59° F.	Temporary
"	50 "	1.67 "	64°-66° F.	100% killed
Nicotine (95%)	30 "	—	60°-61° F.	Nil
"	100 "	—	53°-60° F.	Temporary (slight)
Benzene ...	10 "	1.12 gms.	67° F.	Temporary
Toluene ...	30 "	0.98 "	63°-64° F.	100% killed
Xylene ...	30 "	0.19 "	60°-61° F.	100% active stages killed
" ...	60 "	0.68 "	55°-56° F.	100% active stages killed

These experiments show that naphthalene will not kill red spider at comparatively low temperatures, irrespective of the amount of vapour which is passed over them within a period of 24 hours. The weights for nicotine are not given as this liquid rapidly absorbs moisture from the air when the latter is passed through it: with air previously dried by passing it through concentrated sulphuric acid, .065 gms. passed through the apparatus in 30 minutes at a temperature of 58° F. The apparatus did not set up the standard hoped for, as, in a glasshouse, toluene and pyridine gave no results, and xylol, used at the rate of 20 fluid ounces to 1,000 cubic feet produced only a paralysis of the spider which passed off rapidly. Some experiments were carried out in the volatilisation of sulphur, but great difficulty was experienced in preventing combustion; it is thought that further investigation should be made in the use of this substance as a fumigant. The chlorides of sulphur are unpleasant to handle, and quickly decompose to gases extremely harmful to growing plants.

Naphthalene Fumigation.

Red Spider made its first appearance in the cucumber houses at the Experimental Station at the end of April. The first fumigation by broadcasting grade 16 naphthalene was carried out on May 5th, and only two additional fumigations were necessary for the rest of the season. In no case were the plants in any way injured. An extended circular (No. 2) was published in April giving full directions for "The Control of Red Spider on Cucumbers by Naphthalene Fumigation."

To test the effect of moisture on the volatilisation of naphthalene in a glasshouse, as much water as possible was withheld from tomato pot-plants heavily infested with red spider, and these were placed in a dry chamber which measured 20 ft. $\times$ 14 ft.

On March 29th, 28 ounces grade 16 naphthalene were broadcast on the floor of the house. Until April 1st temperatures ranged from 58° F. to 100° F., and neither plants nor spider were affected, for the naphthalene had obviously not volatilised to any extent. On the latter date the ground and plants were well watered, the odour of naphthalene at once became intolerable, and all the spider and their eggs were killed by April 3rd. The plants showed damage from sun-scorch, but no trace of typical naphthalene vapour injury. Moisture in the atmosphere is therefore an essential to the successful volatilisation of naphthalene when broadcast for fumigating against red spider.

On June 4th a normal fumigation by broadcasting grade 16 naphthalene was carried out in a cucumber house 78 ft. $\times$ 14 ft., but the leaves of the plants were not damped over prior to fumigation, only the borders and paths being watered. As a control a block of houses was similarly treated, but the foliage of the plants was damped over as well as the borders and paths. In each case the spider were killed and the foliage was unharmed. The night temperatures were high during this experiment, and on a nursery where fumigation had been carried out without previous damping over and the night temperature had fallen much, there was considerable scorching of the foliage.

As there appears to be no advantage in keeping the foliage dry at the time of fumigation, and there is some risk if the temperature falls much at night, it is considered safer for the grower to damp over the foliage, as well as to water the paths and borders before broadcasting naphthalene.

Control of Red Spider on Tomato Plants by Spraying.

Late in the season of 1925, a considerable area of tomato plants was sprayed with a 2% solution of potash soft soap, and this had some effect upon the spider, and did not appear to injure the plants. Weaker solutions did not give the same measure of control. The general constituents of soft soap—potassium oleate, potassium stearate and potassium palmitate, were each used in 1% solution on cucumber foliage: none of them had a good killing effect and the last two left a white deposit after spraying. Considerable injury resulted to the leaves of cucumber plants sprayed with 1% solution of potash soft soap. Attempts were made to combine the soft soap solution with liver of sulphur, in order to obtain a greater killing efficiency together with a reduction in the strength of the soap solution. The trials were

successful. A solution containing 0.5% potash soft soap and 0.25% liver of sulphur was taken as a standard, and sprayed with a fine nozzle upon the underside of the foliage of tomato plants ; other plants were similarly sprayed with this solution at double and half strengths respectively, using soft water in each case, and at standard strengths using hard water.

The following effects were noted from observations continuing for a period of 7 days after the application :—

Table 2.

Composition of Spray.	Water.	Effect on Spider.	Effect on Plant.
1 { Soft soap 1% ... Liver of Sulphur 0.5%	Soft	20% eggs hatch. Active and resting stages killed, when contact was effected ...	Leaf edges scorched. Bloom and young shoots injured.
2 { Soft soap 0.5% ... Liver of Sulphur 0.25%	Soft	13% eggs hatch. Active and resting stages killed. Control good ...	No effect.
3 { Soft soap 0.5% ... Liver of Sulphur 0.25%	Hard	All eggs hatch. Some resting stages not killed. Control poor ...	Deposits on leaves: fruit marked: young growth hardened.
4 { Soft soap 0.25% ... Liver of Sulphur 0.125%	Soft	39% eggs hatch. 80% resting stages unaffected: active stages not all killed ...	No effect.

In these sprays, which act by contact, much depends upon the spreading and wetting capacity of the solution used. No. 1 was unexpectedly poor in these respects and a greater proportion of eggs hatched than in the standard: in No. 3, the spreading capacity was impaired by the deposition of salts from the hard water, and it seemed that the action of the liver of sulphur upon the spider was considerably lessened. The standard spray (No. 2) was the most satisfactory from every point. It is surprising that the components of any of the solutions should have had any action at all on the eggs of red spider. The date upon which eggs hatched after spraying showed that only those which were nearing the time of hatching were killed, and the percentages given are therefore hardly comparable, as the eggs on the different plants might have varied in proportion of their advance in development.

Whatever construction may be put upon the results of these experiments, a single application of the standard spray would

seldom effect a complete control of spider on tomato plants. This exceptional condition was, however, realised when 10 tomato plants in the Experimental Station variety house and two whole plots in house K. were sprayed on July 5th. In each case the spider received such a check from one application, that further treatment was not called for during the season. Probably few spiders chanced to be in the egg stage at the time of treatment, and afterwards a natural enemy of red spider referred to later did much in keeping down the infestation. When it became established that this spray could be used with safety on tomato plants, several growers immediately used it over considerable areas. The best results were obtained where the attack of spider was not far advanced, chiefly on account of the fact that a large acreage of tomato plants is extremely difficult to treat when thorough wetting of all foliage is demanded. There is also, at present, considerable difficulty in obtaining large quantities of rain water on nurseries—practically the only form of soft water which can be used economically.

For the convenience of growers the following recommendations are put forward for the preparation and use of this spray :—

Materials Required.

- A good horticultural potash soft soap.
- Commercial liver of sulphur.
- A jar of 2 pints capacity.
- A saucepan of $3\frac{1}{2}$ to 4 pints capacity.
- A clean cloth for straining.
- A bucket of 2 to $2\frac{1}{2}$ gallons capacity.
- Rain-water for mixing and spraying.

Preparation of Stock Solution.

1. Dissolve 4 ounces liver of sulphur in 1 pint cold water in the jar.
2. Heat $\frac{1}{2}$ lb. soft soap in the saucepan without water until the soap is melted. Stir into this gradually 2 pints rain-water, so that no soap lumps remain. Pour this into the bucket, and rinse the saucepan out with 1 pint of rain-water, adding the latter to the contents of the bucket. Allow this to cool. Strain the liver of sulphur, solution (1), through a cloth into the soap solution (2) and stir well.

The stock solution now consists of soft soap $\frac{1}{2}$ lb., liver of sulphur $\frac{1}{4}$ lb. and rain-water 4 pints ($=\frac{1}{2}$ gallon).

If necessary this may be stored in a large glass bottle, corked up, but it will not keep with certainty for more than seven days.

For Use.

In small quantities, take $\frac{1}{2}$ pint stock solution and make up to 1 gallon with rain-water. For large quantities, take the whole stock solution and add to 10 gallons rain-water. In both cases the solution must be well stirred before spraying.

When spraying the finest nozzle obtainable should be used, and about 1 gallon of spray should be applied to every 10 large plants and the underside of the foliage very thoroughly wetted. It is preferable to spray on dull days or in the evening, though no ill effects have as yet been recorded when this has been done in bright sunshine on hot days.

Two applications should be made, the second, one week after the first. It is recommended that rain-water tanks be installed on nurseries, as neighbouring well and pond water is usually too hard for the purpose. Commercial liver of sulphur mostly contains some sulphide of iron, which it is advisable, but not essential, to remove by straining.

Cultural Experiments.

Experiments were begun to determine the effect, if any, displayed by different types of growth of tomato plants in preventing or encouraging the increase of red spider.

Ailsa Craig plants in 12 in. pots were chosen, and subjected to the various treatments from June 1st onwards. The plants, duplicated in each case, were infected with red spider taken from very severely infested plants of Yarmouth variety on June 8th.

The addition of potash in the base appeared to hinder the increase of spider to some extent. The plants of this series (excepting the controls) showed better growth than any of the other series, and for this reason a greater surface for infestation was afforded to the spider. Until further experiments are made, it is unsafe to formulate any conclusion at the present time.

Attack of Spider on Different Varieties of Tomato.

In the variety house at the Experimental Station the following tomatoes showed infestation on July 1st :—

Potentate.—Two plants in one plot, one in the other. One plant severely attacked.

Riverside Favourite.—Two plants in both plots. One plant severely attacked.

Ailsa Craig.—One plant in both plots. One plant severely attacked.

Yarmouth.—One plant in both plots. Very slightly attacked.

Water Baby.—One plant in one plot. Slightly attacked.

Comet.—One plant in one plot. Slightly attacked.

Comet × *Manx Marvel*.—One plant in one plot. Slightly attacked. At the end of the season *Potentate* was most heavily infested.

Incidence of Spider in Tomato Houses.

Two red female spider were found on a single leaf of a plant in the new block of houses (Variety E.S.I.) on March 16th. These were destroyed, and spider did not occur again in these houses during the rest of the season. On June 23rd four plants in House K., Plot 6b. (Variety Manx Marvel, complete artificials without phosphates) were found to be infested. On June 28th two plants in Plot 4a (House K.) had spider upon them.

On June 30th three plants with spider upon them were located in Plot 4b (same treatment as Plot 4a). After spraying with soft soap and liver of sulphur, the attack was greatly checked, and at the end of the season only a slight infestation occurred, and this extended to houses J. and M.

Winter Treatment.

Straw mulch lying on the ground under tomato plants has again been found to contain large numbers of hibernating spider in October and November. The presence of this straw appears, at any rate to some degree, to prevent spider getting up into the ridge prior to hibernation. Under the cold conditions prevailing in tomato houses at this time, the cleansing of the latter with cresylic acid and soft soap is not so effective as in heated cucumber houses; many spider, indeed, escape destruction in exposed positions where the spray can easily reach them. Efforts to obtain a spray which will penetrate beneath the ironwork of ventilator fittings were unsuccessful; paraffin emulsion, and an emulsion consisting of medicinal paraffin, soft soap and cresylic acid, probably the most penetrating spray fluid known, killed only the spider round the edges of the fittings, but failed to pass to the central portions where most spider were congregated. Such a method of control is at any rate hardly practicable on any large nursery, and the most likely solution of the problem seems to lie in preventing the spider from reaching these places of concealment.

Natural Enemies.

On page 93 of the Annual Report for 1925, reference is made to the red grub of a fly—*Therodiplosis persicae* Kieff, belonging to the "gall-midge family" (*Cecidomyiidae*), which is a voracious feeder upon all stages of red spider in tomato houses.

This useful insect has increased very considerably during the season of 1926, and did not seem to be killed where foliage was sprayed with soft soap and liver of sulphur solution.

It made its appearance in July—a full month earlier than in previous seasons—and was possibly responsible for some nurseries heavily infested in 1925 showing a slighter infestation in 1926.

Attempts to breed this insect have so far been attended with difficulties which will no doubt be overcome in time. It has therefore not been possible to determine the period of time spent in the larval stages; the duration of the pupal stage in August is nine days. During July only one grub was found, where any occurred, on single leaves infested with spider, while in August two of three were constantly obtained, and in September a distinct control of spider was effected on tomato plants in a small house into which the insect had been introduced. No doubt this fly must be distributed in large numbers to effect any quick control, and it is not certain as yet whether sufficient numbers can be bred artificially for the purpose.

2. White Fly (*Trialeurodes vaporariorum*, Westw.)

An insect parasite of the greenhouse white-fly was received from Mr. L. Hawkins, of Elstree, Herts, early in July.

This parasite is a Chalcid wasp of minute size, which lays its eggs in the later stage scales of the white fly. These scales, which contain the parasite, turn black some 14 days after receiving an egg, and are then distinguishable from the white unparasitised scales. The parasite has been bred through several generations at the Experimental Station, and efforts are being made to keep it breeding through the winter months. Distributed in the new block of tomato houses in the middle of August, the parasite made good headway until the fires were let out in September. In the old block, infested with the parasite in September, there was a good increase in October when the houses were heated. The life history of the parasite lasts some 28 days from the laying of the egg to emergence of the adult from the surrounding skin of the white-fly scale. The parasite has been identified as *Encarsia formosa* Gahan, previously recorded only from the United States similarly destroying white-fly scales in a glasshouse. Taking into consideration the habits of this insect, there is reason for believing it to be of tropical origin, and at present it is ill-adapted to our climate. However, there are certain characteristics which may yet make it a valuable agency in the control of white-fly in glass-houses, these are as follows:—

1. Successive generations consist entirely or nearly entirely of females, which lay fertile eggs without intervention of the male sex.
2. The insect is easily distributed artificially when developing within the scale of the white-fly, as, after the black colour appears, some 14 days elapse before emergence takes place.
3. The parasite can fly long distances in search of white-fly scales in a condition to receive its egg.

4. When developing within the scales of white-fly, the parasite is unharmed by ordinary cyanide fumigation.
5. There is no possibility of the parasite causing any damage to vegetation.

The efficiency of the parasite in controlling white-fly depends upon its ability to increase in glasshouses in the early months of the season—April to June—and should it be possible to establish the insect, the saving to the growing community in material and labour for the control of white-fly would be large.

3. Mushroom Pests.

In January and February a collection was made of animals infecting mushroom beds laid down at the Experimental Station. Amongst these were some of especial interest, both economic and scientific. The bright orange-coloured grub of an exceedingly minute fly fed upon the mycelium; this fly is new to science and belongs to the gall-midge family (*Cecidomyiidae*); it has been described by Mr. H. F. Barnes, who named it *Pezomyia speyeri*. An allied midge, *P. wandervulpi* Meij, was found with it. The distribution of these insects is at present unknown, and they may be pests of considerable importance to the grower.

The white grubs of Sciarid flies, *Sciara auripila* Winn, belonging to the fungus gnats (*Mycetophilidae*) were responsible for the chief damage, as they ate holes into the developing mushrooms and were present in vast numbers. From previous records, it appears that Sciarid flies may be the most destructive of all mushroom pests. At least, one species of spring-tail (*Aptera*) belonging to the genus *Achorutes*, also plentiful in cucumber houses, ate into the caps of such mushrooms as were able to develop after the attacks of the above-mentioned insects. Of the numerous mites infesting the beds, the majority were predatory *Gamasids*, which appeared to act neither in a very beneficial nor in a harmful way. A cheese-mite—*Tyroglyphus lintneri* Osb. -fed only upon mushrooms which had previously been injured through other causes.

General consideration on the Control of Pests in Mushroom Beds.

Adding to the above list the occurrence of the destructive garden root-fly (*Bibio hortulanus* Mg.) and a Millipede (*Blanjulus gutturalis*, Bosc. and Gerv.), it became apparent that the majority of the mushroom-growers' troubles arise from the materials of which the bed is composed. Once the pests start breeding after the spawn is running, any economic control seems out of the question. Fumigation with nicotine, volatilising $\frac{1}{2}$ to 1 ounce per 1,000 cubic feet space, killed most of the sciarid flies which had emerged from the bed, but left millions of grubs in the soil entirely

unharmful, and the cost of repeated fumigations became prohibitive. The effects of hydrocyanic acid gas and of pyridine vapour were less than those of nicotine. Portions of beds were sprayed with solutions of nicotine and pyridine up to 1% strength without result, and similar failures attended the use of nicotine dusts and pyrethrum. Experiments are shortly being made to determine if mushrooms can be grown in small enclosed spaces, and further investigation into the treatment of materials of which the beds are composed, can only be proceeded with if the outcome of the experiments is successful.

4. Other Animals of Interest found in Glasshouses.

Cucumber Houses.

Several animals of some economic importance injure the foliage of cucumber plants early in the season. One of these, a mite, *Tyroglyphus longior* Gerv., known to growers as "French Fly," causes perforations of the leaves of young plants shortly before or after they are placed in the borders. Under favourable conditions they will produce one or two generations on the plants up to the middle of March. Apparently this mite is brought into the houses in straw of which the borders are partially made up. It is easily controlled by scattering a light dressing of naphthalene on the paths of the houses, and raising the temperature as much as possible for a period of two to four days.

An insect causing somewhat similar, but rougher perforations of the leaf is the large green spring-tail, *Smynturus viridis* L., which is of a most grotesque appearance and hops with extreme violence if disturbed. Records suggest that this pest gains access to the houses in clover-containing turf used in enriching the borders. Lucerne is the usual host of this spring-tail, which does not breed in cucumber houses, so that the attack never lasts long. If they are sufficient in numbers to cause severe injury, the foliage of the plants should be sprayed with 6 ounces lead arsenate paste, and $\frac{1}{4}$ ounce Saponin in 10-12 gallons water, before the fruit has begun to develop.

Tomato Houses.

An interesting fungus-gnat, *Hyperlasion curtipennis*, Edwards, new to science, was recorded from Clacton-on-Sea in December, 1926.

The yellow grubs of this fly, which might be mistaken at first sight for young wireworm, have the habit of massing themselves into large balls in the ground, sallying forth at night and collecting together again in the day. The adult flies emerged in January,

1926. The portion of a house in which they were collected bore a poor crop during the season of 1925, and the grubs may therefore feed upon the roots of tomato plants.

The leaf-mining grub of a *Trypetid* fly, at present awaiting identification, but probably identical with the insect which mines the leaves of sow-thistle (*Sonchus oleracea*) did considerable damage to tomato plants at Edmonton in July over an area of $4\frac{1}{2}$ acres.

The grubs leave their mines when full-fed, and pupate in the ground for a period of nearly three weeks. The infestation probably arose from weeds in the houses. The brown or clover-mite, *Bryobia pretiosa* Garm., appeared in numbers on tomato foliage at Hoddesdon in April, and was also sent in upon the weed *Lamium purpureum* from a tomato house in Cheshunt in March. This mite is much larger than the common red spider, and did much damage to foliage of a few plants. Only adults were present in each case, and no eggs having been laid the attack, traceable to dandelions growing in the vicinity of the houses, soon died out.

Grubs of the root-fly, *Diplophus febrilis* L., destroyed seedlings pricked out into unsterilised soil at Bishops Stortford in December, 1925.

Vines and Peaches under Glass.

A serious outbreak of the Tortrix moth, *Tortrix diversara* Hb., on peaches was reported from Finchley in April. The caterpillars gnaw the base of developing fruit. Control of this pest is at present difficult, as spraying with lead arsenate is not permissible after the fruit is formed.

Another Tortrix moth, *Tostrix podana* Scop., is a very serious pest of vines. The caterpillars weave the leaves together, and at night damage the ripening grapes. Female moths caught in jars containing beer, treacle and sodium fluoride, were dissected in July, and were proved to have visited the traps before laying their eggs. The occurrence of this moth in vineries may originate from ivy, in which the moth lives commonly, growing on buildings nearby.

Roses and Carnations under Glass.

The Onion Thrips (*Thrips tabaci* Lind.) often a pest of cucumber, causes much damage to flowers of roses and carnations. As they live within the sepals of the unopened bloom, no method of control is as yet established.

5. List of Animals Affecting and Associated with Glasshouse Crops.

Recorded by the Experimental and Research Station since 1920.

I. EELWORMS		...	<i>Nematoda</i> .	...	Injurious.	Roots of Tomato and Cucumber.
1.	Club-root	...	<i>Heterodera radicicola</i> Muell.	...	"	Foliage of Chrysanthemum.
2.	Leaf eelworm	...	<i>Aphelenchus ritzemabosi</i> Schw.	...	"	Bulbs of Narcissus and Cyclamen.
3.	Bulb eelworm	...	<i>Tylenchus devastatrix</i> Kuhn	...	"	
II. EARTH-WORMS		...		...		
1.	Soil-worms	...	<i>Annelida (Oligochaeta)</i> .	...	Harmless or useful.	Soil at roots of Tomato.
2.	"	...	<i>Enchytraeus albidus</i> ...	...	"	Calla.
3.	"	...	<i>minimus</i> Bretsch	...	"	"
		...	<i>Henlea fragilis</i> Friend	...	"	Carnation.
III. WOODLICE		...	<i>Crustacea (Isopoda Oniscoidae)</i>	...		
1.	Cucumber house woodlouse	...	<i>Armadillidium speyeri</i> Jackson]	...	Injurious.	Roots, stem and foliage of Cucumber ; Tomato Seedlings ; Flowers of Carnation ; Adiantum Fern.
2.	Pill woodlouse	...	<i>vulgare</i> Latr.	...	Injurious.	Roots, stem and foliage of Tomato and Cucumber ; Stem of Peach.
3.	"	...	<i>nasatum</i> B-Lund	...	Injurious.	Roots of Orchids.
4.	"	...	<i>pictum</i> Brandt	...	"	Rare in Cucumber houses.
5.	Common woodlouse	...	<i>Oniscus asellus</i> L. ...	...	"	Foliage of Orchids.
6.	"	...	<i>Trichoniscus roseus</i> Koch	...	"	Roots of Orchids.
7.	" Runners "	...	<i>Porcellio laevis</i> Latr.	...	"	Roots of Cucumber.
8.	"	...	<i>dilatatus</i> Brandt	...	"	"
9.	"	...	<i>scaber</i> Latr.	...	"	Orchids.
10.	"	...	<i>ratzeburgii</i> Brandt	...	"	"
11.	"	...	<i>Porcellionides pruinosus</i> Latr.	...	Probably harmless.	Tomato houses and Cucumber houses.
12.	"	...	<i>Philoscia muscorum</i> Scop.	...	"	Cold frames.
13.	"	...	<i>Haplophthalmus danicus</i> B-Lund...	...	"	Tomato and Carnation houses.
IV. MITES		...	<i>Acarina</i> .	...		
1.	Red Spider	...	<i>Tetranychus telarius</i> L.	...	Injurious.	Foliage of Cucumber, Tomato, Vine, Carnation, Rose, Peach, Melon, Asparagus, Strawberry, Violet and Legumes.
2.	Brown mite	...	<i>Bryobia pretiosa</i> Garm.	...	Injurious.	Foliage of Tomato (occasional).
3.	Cheese mite	...	<i>Tyroglyphus longior</i> Gerv.	...	"	Foliage of Cucumber.

IV. MITES—continued.

4.	...	...	...	...	<i>Tyroglyphus lintneri</i> Osb.	...	Injurious.	Cap of Mushroom.
5.	...	...	...	...	<i>Allothrombium fuliginosum</i> De Geer	Probably harmless.	Probably harmless.	Foliage of Tomato.
6.	...	...	...	...	<i>Damaeus nitens</i> Koch	...	"	Roots of Cucumber.
7.	...	...	...	...	<i>Gamasids</i> undetermined	...	"	Mushroom.
8.	...	...	...	...	<i>Gamasids</i> undetermined	...	Beneficial.	Predator on the Red Spider on Cucumber.

V. MILLIPEDES

1.	Strawberry millipede	...	...	...	<i>Myriapoda</i> .	...	Injurious.	Roots of Tomato and Mushroom.
2.	Hot-house millipede	...	...	...	<i>Blanjulus guttulatus</i> Bosc.	...	Probably harmless.	Cucumber and Tomato houses.
3.	...	...	...	...	<i>Orthomorpha gracilis</i> Koch	...	"	Soil of Tomato houses.
4.	...	...	...	...	<i>Cylindroiulus londinensis</i> ...	...	"	"
5.	...	...	...	...	<i>Nopoiulus minutus</i> Brandt	...	"	"
...	...	...	...	...	<i>Ophijulus pilosus</i> ...	...	"	"
...	...	...	...	...	<i>Insecta</i> .	...	"	"

VI. INSECTS ...

A. SPRING-TAILS

1.	...	...	...	...	<i>Aptera</i> (<i>Collombola</i>).	...	Injurious.	Cap of Mushroom.
2.	...	...	...	...	<i>Achorutes armatus</i> Nic.	...	"	"
3.	Lucerne Flea	...	...	...	" <i>purpurescens</i> Lubb.	...	"	and roots of Cucumber.
4.	...	...	...	...	<i>Smynthurus viridis</i> L.	...	"	Foliage of Cucumber.
5.	...	...	...	...	<i>Xenylla humicola</i> Fab.	...	Probably harmless.	Soil of Cucumber houses.
6.	...	...	...	...	<i>Lipura ambulans</i> ...	...	"	"
...	...	...	...	...	<i>Orchesella villosa</i> Geoff.	...	"	"
...	...	...	...	...	<i>Coleoptera</i>	...	"	Soil of Tomato houses.

B. BEETLES.

(a) Wireworms, Click Beetles Elateridae.

1.	...	...	...	...	<i>Agristes lineatus</i> L.	...	Injurious.	Larva in stems of Tomato. Adult on foliage of Cucumber seedlings.
2.	...	...	...	...	" <i>obscurus</i> L.	...	Injurious.	Larva in stems of Tomato.
3.	...	...	...	...	" <i>sputator</i> L.	...	"	"
4.	...	...	...	...	<i>Athous haemorrhoidalis</i> F.	...	"	Cucumber houses.

(b) Weevils ...

1.	Black Vine weevil	...	...	...	<i>Curculionidae</i> .	...	Injurious.	Larva on roots, adults on foliage of Rose, Maidenhair Fern and Cyclamen.
2.	...	...	...	...	<i>Otiorrhynchus sulcatus</i> F. ...	...	Probably harmless.	In soil of Tomato houses.
...	...	...	...	...	<i>Barynotus obscurus</i> F.	...	Injurious.	Roots of Tomato.
...	...	...	...	...	<i>Lamellicornia</i> .	...		
...	...	...	...	...	<i>Melolontha melolontha</i> L. ...	...		

(c) Chafers ...

1. Cockchafer

VI. INSECTS—continued.

2.	...	<i>Aphodius foetens</i> F.	...	...	Probably harmless.	In soil of Cucumber and Tomato houses.
3.	...	" <i>granarius</i> L.	...	...	"	In soil of Tomato houses.
4.	...	... <i>Oryctolus porcatus</i> F.	...	...	"	"
(d) Cloth beetles	...	...	...	...	"	"
1.	...	... <i>Dermestidae</i> .	...	...	Injurious.	Devouring seeds of Tomato.
(e) Glow-worms	...	... <i>Anthrenus verbasci</i> L.	...	...	Beneficial.	Predatory on Woodlice in Tomato houses.
1.	...	... <i>Malacodermidae</i> .	...	...	Beneficial.	Predatory on Woodlice in Tomato houses.
(f) Devil's coach-horses	...	... <i>Telephorus fuscus</i> L.	...	...	Beneficial.	Feeding on insects in Cucumber houses.
1. Large black coach-horse	...	... <i>Staphylinidae</i> .	...	...	"	"
2. Small "	...	... <i>Ocyptus morio</i> Gr.	...	...	"	"
3. Brown coach-horse	...	... <i>Leistotrophus nebulosus</i> F.	...	...	"	"
4.	...	... <i>olens</i> Mull.	...	...	Probably harmless.	Tomato houses.
5.	...	... <i>Falagria obscura</i> Gr.	...	...	"	"
6.	...	... <i>Gabrieus trossulus</i> Nord.	...	...	"	"
7.	...	... <i>Homalota atramentaria</i> Gyll.	...	...	"	"
8.	...	... <i>Quedius impressus</i> Pz.	...	...	"	"
9.	...	... <i>Tachinus subterraneus</i> L.	...	...	"	"
(g)	...	... <i>Megarthus sinuaticollis</i> Lac.	...	...	"	Mushroom soil.
1.	...	... <i>Corylophidae</i> .	...	...	Probably harmless.	Tomato houses.
2.	...	... <i>Cercyon analis</i> Pk.	...	...	"	Associated with brown mite.
(h) Ground beetles	...	... <i>Sericoderus lateralis</i> Gyll.	...	...	"	"
1.	...	... <i>Carabidae</i> .	...	...	Possibly beneficial.	Soil in Cucumber houses.
2.	...	... <i>Amara simulata</i> Gr.	...	...	"	Soil in Tomato houses.
3.	...	... <i>Harpalus discoideus</i> Fab.	...	...	"	"
(i) Powder-post beetles	...	... <i>Notiophilus biguttatus</i> Fab.	...	...	"	"
1.	...	... <i>Bostrichidae</i> .	...	...	Injurious.	Imported in bamboo canes from China, boring into Vine canes.
(j) Long horn beetles	...	... <i>Phonapate</i> sp.	...	...	Injurious.	Imported in canes from China.
1.	...	... <i>Cerambycidae</i> .	...	...	"	"
C. EAWIGS	...	... <i>Diboma posticata</i> Gah.	...	...	Injurious.	Flowers of Chrysanthemum, foliage of Cucumber.
1. Common earwig	...	... <i>Dermaptera</i> .	...	...	"	"
	...	... <i>Forficula auricularia</i> L.	...	...	"	"

VI. INSECTS—continued.

(h) Hover Flies ...		... <i>Syrphidae</i> .			
1. Drone fly ...		... <i>Eristalis tenax</i> L. ...	...	Injurious.	Fertilising Cucumber flowers (larvae in water tanks).
2. Lesser bulb fly		... <i>Eumerus strigatus</i> Fall. ...	...	Injurious.	Bulbs of Narcissus (larva).
(i) Leaf Miners		... <i>Agromyzidae</i> .			
1. Chrysanthemum leaf miner		... <i>Phytomyza albiceps</i> Meig. ...	...	Injurious (larva).	Foliage of Chrysanthemum.
2. Sow thistle miner		... <i>Agromyza</i> sp. ...	...	" "	" Tomato.
(j) ...		... <i>Borboridae</i> .			
1. ...		... <i>Limosina quisqualis</i> Hal. ...	...	Probably harmless.	Mushroom bed.
2. ...		... " sp. ...	...	" "	Soil of Tomato seed boxes.
(k) ...		... <i>Phoridae</i> .			
1. ...		... <i>Aphiochaeta halterata</i> Wood	...	Probably harmless.	Soil of Mushroom beds.
(l) House Flies		... <i>Muscidae</i> .			
1. Stable fly		... <i>Stomoxys calcitrans</i> L. ...	...	Injurious (adult).	Biting man in Cucumber houses.
E. Bugs		... <i>Hemiptera</i> .			
(a) Capsid Bugs		... <i>Capsidae</i> .			
1 Tarnished plant bug		... <i>Lygus pratensis</i> L. ...	...	Injurious.	Stem of Chrysanthemum.
2. Diamond back bug		... <i>Liocoris tripustulatus</i> F. ...	...	" "	"
3. Green runner bug		... <i>Calocoris norvegicus</i> Gmel. ...	...	" "	Foliage of young Cucumber.
(b) ...		... <i>Reduviidae</i> .			
1. ...		... <i>Nabis lativentris</i> Boh. ...	...	Beneficial.	Predatory on insects on Chrysanthemum.
F. PLANT LICE		... <i>Homoptera</i> .			
(a) White flies		... <i>Aleurodidae</i> .			
1. Greenhouse white fly		... <i>Trialeurodes vaporariorum</i> Westw.	Injurious.	Foliage of Tomato, Cucumber, Legumes, Tobacco, Primula, etc.	
2. ...		... <i>Trialeurodes sonchi</i> Kot. ...	...	Injurious.	Foliage of Tomato (occasional).
3. Cabbage white fly		... <i>Aleurodes proletella</i> L. ...	...	" "	Cabbage.
(b) Green fly		... <i>Aphidae</i> .			
1. Chrysanthemum aphid		... <i>Aphis helichrysi</i> Kalt. ...	...	Injurious.	Foliage of Chrysanthemum.
2. Cotton aphid		... " <i>gossypii</i> Glov. ...	...	" "	Foliage of Cucumber.

VI. INSECTS—continued.

3. Bean aphid	...	...	<i>Aphis rumicis</i> L.	...	...	Injurious.	Foliage of Tomato.
4. Green potato aphid	...	...	<i>Macrosiphum solanifolii</i> Ashm.	...	...	"	Foliage of Tobacco.
(c) Hoppers	...	...	<i>Jassidae</i> .	...	...	...	...
1. Geranium hopper	...	...	<i>Erythroneura parvulus</i> Boh.	...	...	Injurious.	Foliage of Cucumber, Geranium, Chrysanthemum, etc.
2. "	...	...	<i>Athysanus lineolatus</i> Brul.	...	...	Injurious.	Foliage of Cucumber.
(d) Frog hoppers	...	...	<i>Cercopidae</i> .	...	...	...	...
1. Cuckoo spit	...	...	<i>Philaenus spumarius</i> Fall.	...	...	Injurious.	Foliage of young Cucumbers.
G. ANT'S, BEES AND WASPS...			<i>Hymenoptera</i> .				
(a) Gall wasps	...	...	<i>Chalcididae</i> .	...	...	...	...
1. "	...	...	<i>Encarsia formosa</i> Gahan.	...	...	Beneficial.	Parasite of White-fly on Tomato.
2. "	...	...	" <i>partenope</i> Masi.	...	...	"	"
(b) Ichneumon wasps	...	...	<i>Ichneumonidae</i> .	...	...	...	...
1. "	...	...	<i>Pimpla instigator</i> F.	...	...	Beneficial.	Parasites of caterpillars on Tomato.
(c) "	...	...	<i>Braconidae</i> .	...	...	...	...
1. "	...	...	<i>Praon</i> sp.	...	...	Beneficial.	Parasite of Mushroom fly.
(d) Bees	...	...	<i>Apidae</i> .	...	...	...	...
1. Honey bee	...	...	<i>Apis mellifica</i> L.	...	...	Injurious.	Fertilising Cucumber flowers.
(e) Ants	...	...	<i>Formicidae</i> .	...	...	...	...
1. "	...	...	<i>Myrmica</i> sp.	...	...	Injurious.	Destroying Cucumber flowers.
H. MOTHS	...	...	<i>Lepidoptera (Heterocera)</i> .				
(a) Cut-worms	...	...	<i>Noctuidae</i> .				
1. Tomato moth	...	...	<i>Polia oleracea</i> L.	...	...	Injurious (larva).	Foliage, stem and fruit of Tomato; foliage of Cucumber and Asparagus; flowers of Carnation.
2. Angle shades moth	...	...	<i>Phlogophora meticulosa</i> L.	...	...	Injurious (larva).	Foliage of Tomato.
3. "	...	...	<i>Apamea secalis</i> L.	...	...	"	"
4. Cabbage moth	...	...	<i>Bathra brassicae</i> L.	...	...	"	"
5. Yellow underwing	...	...	<i>Agrotis pronuba</i> L.	...	...	"	Stem of Chrysanthemum.
6. Lesser broad border	...	...	" <i>janthina</i> W.V.	...	...	"	"

VI. INSECTS—continued.

(b) Tortrix Moths ...		... Tortricidae.			
1. ...	...	...	...	...	Injurious (larva). Foliage and fruit of Peach.
2. ...	...	...	...	...	" " Vine.
3. ...	...	...	...	...	" " Flowers of Carnation.
4. ...	...	...	...	...	" " Foliage of young Cucumbers.
1. GRASSHOPPERS, CRICKETS Orthoptera.					
(a) Crickets ...		... Gryllidae.			
1. House cricket ...	...	...	...	...	Injurious. Foliage of Cucumber.
(b) Grasshoppers ...		... Acrididae.			
1. Greenhouse grasshopper	Tachycines asynamorus Ad.	...	...	...	Injurious. Vine.
J. THIRPS ...		... Thysanoptera.			
1. Onion thrips ...	... Thrips tabaci Lind.	...	...	...	Injurious. Flowers of Rose and Carnation ; Foliage of Cucumber and Tomato.
2. ...	... flavus Schr.	...	...	...	Injurious. Foliage of Cucumber.
3. Greenhouse thrips	... Heliothrips haemorrhoidalis Bou.	...	...	...	" " Aspidium sp.
VII. SLUGS AND SNAILS... Mollusca.					
1. Garden slug ...	... Arion hortensis Fer.	...	...	...	Injurious. Foliage of Cucumber.
2. Common snail	... Helix aspersa Mull.	...	...	...	" " Foliage of Cucumber and Melon.
VIII. FROGS AND TOADS Amphibia.					
1. Common toad	... Bufo vulgaris L.	...	...	...	Beneficial. Eating Crickets in Cucumber houses.
2. Common frog	... Rana temporaria L.	...	...	...	" " Eating insects in Cucumber houses.

5. Carbon Dioxide Investigations.

T. SMALL.

These investigations, designed to determine if heavier and better crops can be obtained by artificially enriching the atmosphere in glasshouses with carbon dioxide, have been continued. Previous experiments, conducted during 1924 and 1925, indicated that heavier cucumber and tomato crops can be obtained in this way.

The generation of carbon dioxide from sodium bicarbonate and sulphuric acid is not a method for use on a large scale, and an attempt has been made this year to find an alternative method.

The "Cardyox" apparatus has given encouraging results. Other results obtained this year indicate that the mechanical mixing of carbon dioxide and air by means of a fan is not essential.

In the Eleventh Annual Report, page 120, it is shewn that the main increase in crop due to the treatment occurs in June and September. In view of this it was decided to determine, in the case of tomato plants supplied with carbon dioxide, whether it is more profitable to grow two crops than to leave the original plants in the houses during the entire season.

The present report is therefore divided as follows :—

1. Experiments carried out during first half season.

2. " " " " second "

Experiments carried out during the first half season.

Each chamber was planted with 56 tomato plants, variety "Tuckswood." The plants were stopped at the third truss, and no side shoots were allowed to develop. The treatment in the chambers commenced after planting and was as follows :—

X1. Carbon dioxide supplied by fermentation of manure in a tank in the chamber.

X2. Control.

X3. "Cardyox" apparatus. This apparatus was used twice daily from 9 a.m. to 11 a.m., and from 3 p.m. to 5 p.m.

X4. Control.

X5. An average concentration of 0.6% carbon dioxide daily from 9 a.m. to 10 a.m. Fan used to distribute the gas uniformly throughout the chamber.

X6. An average concentration of 0.6% carbon dioxide daily from 9 a.m. to 10 a.m. No fan used.

The cultural conditions in each chamber were normal and, temperature records showed that the average temperature was

approximately the same in all chambers. Tomato plants were planted on January 15th, while the carbon dioxide treatment commenced on March 3rd and finished on May 15th.

The results are summarised in Table 1.

Table 1.

Chamber.	Treatment.	Pounds per Plant.	Tons per Acre.	Relative Values.
X1	*Carbon dioxide by fermentation ...	1.93	11.58	101
X2	Control	1.71	10.26	—
X3	"Cardyox" apparatus. Twice daily from 9 a.m. to 11 a.m. and 3 p.m. to 5 p.m.	2.47	14.82	129
X4	Control	2.13	12.78	—
X5	0.6% carbon dioxide once daily from 9 a.m. to 10 a.m. Fan used ...	2.01	12.06	105
X6	0.6% carbon dioxide once daily from 9 a.m. to 10 a.m. Fan not used ...	2.37	14.22	123
	Average of Controls	1.92	11.52	100
	" Treated (omit X1.)	2.28	13.68	119

* Fermentation was slow and the concentration of carbon dioxide in the air was almost normal.

The results show that increased crops were obtained in X3 and X6. The increase in X3 when the "Cardyox" apparatus was used was encouraging, and the experiment was repeated in the second half season.

The result in X5 was unexpected and perplexing, because the treatment was similar to that applied in previous years, when it increased the crop. It is difficult to believe that the difference in treatment alone was responsible for the difference in crop yield in X5 and X6. In each of these chambers 6 lbs. of sodium bicarbonate were decomposed with sulphuric acid, and the only difference in treatment was that the gas in X5 was mechanically mixed with a fan, whereas that in X6 was allowed to diffuse into the atmosphere of the chamber. Analysis of samples taken in the two chambers are given below. Table 2 summarises the analysis of samples taken immediately after decomposition in X5, at the centre of each side of the chamber, and at different heights from the ground.

Table 2.

Theoretically 114 parts Carbon Dioxide per 10,000.

Height from Ground.	Wall of Chamber.			
	N.	S.	E.	W.
6 inches	97.47	91.64	91.70	94.01
6 feet	98.58	101.60	93.91	88.26

Tables 3 and 4 summarise the analysis of samples taken in X6 at different times and in different positions :—

Table 3.

Time of Sampling.	Height from Ground.	Wall of Chamber.			
		N.	S.	E.	W.
Immediately after decomposition	6 ins.	659.20	450.30	450.90	626.30
" " "	6 ft.	39.15	74.87	47.22	30.96
30 minutes after decomposition	6 ins.	72.02	75.70	69.45	65.15
" " "	6 ft.	76.95	82.85	78.02	77.87

Table 4.

Time of Sampling.	Height from ground in centre of Chamber.	Carbon dioxide in parts per 10,000.
Immediately after decomposition ...	6 inches	491.70
" " " ...	6 feet	44.52
" " " ...	12 "	55.43
15 minutes after decomposition ...	6 inches	86.54
" " " ...	6 feet	81.81
" " " ...	12 "	101.04
30 minutes after decomposition ...	6 inches	63.02
" " " ...	6 feet	67.22
" " " ...	12 "	68.52

Tables 2, 3 and 4 clearly indicate that, except for a short period of marked stratification in X6, the gas was uniformly distributed in the chambers.

In X1 there was no increase. The material used for the fermentation process in this chamber was a mixture of three parts steamed tomato haulms and one part stable manure, which was kept moist with a 1% solution of cane sugar. The mixture was contained in, and filled, a metal tank of 10 cubic feet capacity, and was placed along one side of the chamber.

Tomato haulms are plentiful at the end of the season, and if, by fermentation, this material could be made to yield sufficient carbon dioxide, the cost of the process would be lowered.

The analysis of samples taken in X1 showed that only four to six parts carbon dioxide per 10,000 were usually present, and hence no increase in crop was to be expected.

Experiments carried out during second half season.

Each chamber was planted with 56 tomato plants, variety "Rochford's Improved Ailsa Craig." The plants were "stopped"

at the fifth truss, and no side shoots were allowed to develop. The treatment in the chambers commenced after planting and was as follows:—

X1. "Cardyox" apparatus. This apparatus was used twice daily, from 9 a.m. to 11 a.m. and from 3 p.m. to 5 p.m.

X2. Control.

X3. "Cardyox" apparatus. Ditto X1.

X4. Control.

X5. An average concentration of 0.6% carbon dioxide daily, from 9 a.m. to 10 a.m. Fan used to distribute the gas uniformly throughout the chamber.

X6. An average concentration of 0.6% carbon dioxide daily, from 9 a.m. to 10 a.m. No fan used.

The dates of the cultural operations were as follows:—

Tomato plants planted June 9th, 1926.

Carbon dioxide treatment commenced July 7th, 1926.

" " " finished August 27th, 1926.

The results obtained are summarised in Table 5.

Table 5.

Chamber.	Treatment.	Pounds per Plant.	Tons per Acre.	Relative Values.
X1	"Cardyox" apparatus twice daily from 9 a.m. to 11 a.m. and 3 p.m. to 5 p.m.	2.35	14.10	112
X2	Control	2.06	12.36	—
X3	"Cardyox" apparatus twice daily from 9 a.m. to 11 a.m. and 3 p.m. to 5 p.m.	2.27	13.62	108
X4	Control	2.13	12.78	—
X5	0.6% carbon dioxide once daily from 9 a.m. to 10 a.m. Fan used ...	2.18	13.08	104
X6	0.6% carbon dioxide once daily from 9 a.m. to 10 a.m. Fan not used ...	2.07	12.42	98
	Average of Controls ...	2.10	12.60	100
	" Treated ...	2.22	13.32	106

In discussing the results it should be borne in mind that the period of treatment was shorter than in the first half season, and that "Tomato Mildew" interfered with the experiments. Nevertheless, the results show evidence of increased crops due to the treatment, and that this increase is greatest in chambers X1 and X3.

The daily treatment with the "Cardyox" apparatus differs in two important respects from that in X5 and X6. Whereas X1 and X3 received 35.3 cubic feet of carbon dioxide, X5 and X6 received only 25.68 cubic feet; and whereas in X1 and X3 the gas was evolved continuously over two periods, each of two hours,

the gas in X5 and X6 was all generated at once, and the concentration in the atmosphere of the chambers gradually decreased until the end of the hour when the ventilators were opened. The question arises as to whether the better results obtained with the "Cardyox" apparatus are due to either, or both, of these differences.

Apart from these considerations, the method used in X1 and X3 is worth trying on a larger scale on commercial nurseries, and it is hoped that such trials may be conducted during the next season.

A brief description of this apparatus is given below.

The "Cardyox" Apparatus.

The apparatus is a light portable stove in which specially prepared fuel is burned. The amount of fuel supplied to the stove at any one time is determined by the prevailing temperature and light conditions. The higher the temperature and the brighter the light, the more fuel is used. A little methylated spirit is sufficient to ignite the fuel, and the stove may be placed in any required position and needs no further attention. Carbon dioxide is evolved continuously during about two hours.

Typical analyses of samples taken in X3 are shown in Table 6. The samples were taken along one side of the chamber and about 6 feet from the ground. The "Cardyox" apparatus was situated on the ground in the centre of the chamber, and five blocks of fuel were used.

Table 6.

Time in minutes from the commencement of treatment.	Carbon dioxide in parts per 10,000.
0	3.55
45	18.44
60	23.14
105	23.56
135	18.18

The results show that the concentration of carbon dioxide was at least 0.18% for $1\frac{1}{2}$ hours.

The cultivation of two crops, planted in January and July, under the prevailing economic and weather conditions did not prove more profitable than a single crop carried through the entire season, but this result must not be taken as a guide to commercial methods. The first crop was not picked sufficiently early to give the second crop the best chance, and the latter, being

later, came to maturity when fuel was difficult to obtain. "Mildew" became serious, and the health of the plants suffered. This experiment arose from the findings of last year when treatment with carbon dioxide had the greatest effect during June and September, and it seemed probable that the new plants would react to the treatment in September even better than the old plants. Under normal conditions the result might be quite different.

Summary.

The result of the work carried out this year would appear to indicate that :—

- 1 Of the methods tested for raising the carbon dioxide content of glasshouse atmosphere, the "Cardyox" apparatus has given the best results.
- 2 The attempt to grow two crops in one season was not profitable.
- 3 The mechanical mixing of the carbon dioxide is not essential.

Table 7.

Year.	Chamber.	Treatment.	Pounds per Plant.	Relative values.
1924	X1	Tomatoes. Control	8.59	—
	X4	" "	7.59	—
		Average of Controls	8.09	100
	X2a	Tomatoes. 0.9% carbon dioxide for 2 hours 40 minutes daily before planting. 0.6% carbon dioxide for 1 hour daily after planting	9.64	119
	X2b	Tomatoes. 0.6% carbon dioxide 1 hour daily after planting	10.14	125
	X5a	Tomatoes. 0.9% carbon dioxide for 2 hours 40 minutes daily when in boxes and pots	8.54	106
	X5b	Tomatoes. 0.9% carbon dioxide for 2 hours 40 minutes daily when in boxes	9.21	114
1925	X1	Cucumbers. Control	38.45	100
	X2	Cucumbers 0.9% carbon dioxide 1 hour daily after planting	44.49	116
	X3	Tomatoes. 0.6% carbon dioxide 1 hour daily after planting	7.28	125
	X4	Tomatoes. Control	5.81	100
1926 (First half season)	X2	Tomatoes. Control	1.71	—
	X4	" "	2.13	—
		Average of Controls	1.92	100
	X3	Tomatoes. "Cardyox" apparatus	2.47	129
	X5	Tomatoes. 0.6% carbon dioxide 1 hour daily after planting. Fan used	2.01	105
	X6	Tomatoes. 0.6% carbon dioxide 1 hour daily after planting. Fan not used	2.37	123

The present stage of the investigations appears to be opportune for a brief outline of the work carried out and of the results obtained.

The work of determining the carbon dioxide content of glasshouse atmospheres under normal conditions, and of devising experimental methods whereby an atmosphere containing any required concentration of gas could be prepared at will, was completed by the end of 1923. From 1924-1926 the effect of atmospheres enriched in carbon dioxide has been tested on tomato and cucumber crops and the results obtained are summarised in Table 7. Examination of this table shows that, on the scale of the experiments, the treatment leads to an increase in crop. It remains to be seen whether such increases would be gained under commercial conditions.

6. The Blooming and Fruiting Period of the Tomato Plant—Progress Report.

W. CORBETT.

The investigation, commenced in 1925, has been continued during the present season.

Daily records were made of the growth of tomato plants, and included—

- (1) the opening of each flower ;
- (2) the pollination of each flower ; and
- (3) the picking of each fruit.

It was assumed that a flower was pollinated when the petals began to fade and shrivel.

The experiments of 1925 were repeated on two plants of Ailsa Craig situated in the middle of a plot in the Variety House. The records obtained confirmed previous findings concerning the "maturation period," or the time taken between the opening of the flower and the subsequent picking of the fruit.

In 1925 it was found that the "maturation period" was not the same for every fruit on the plant. That of all the fruits of the first truss and the first seven or eight fruits of all the other trusses was reasonably constant ; but the later fruits of the second, third and fourth trusses took longer to ripen, and, therefore, there was a sudden increase in the "maturation period." Particularly prominent was the sudden lengthening of the "maturation period" of successive fruits occurring in trusses 2, 3 and 4. Also, it was found that the average "maturation period" of the successive trusses lengthened up to the third truss, after which, for the fourth and fifth, it became shorter.

This year similar results were obtained from one plant, whilst for the second plant, the "maturation period" of each fruit was practically a constant. A detailed analysis of the results from the two plants under observation is given in Table 1.

Table 1.

TRUSS 1.			TRUSS 2.			TRUSS 3.			TRUSS 4.			TRUSS 5.		
Fruit No.	Length, in days, of "Maturation Period"		Fruit No.	Length, in days, of "Maturation Period"		Fruit No.	Length, in days, of "Maturation Period."		Fruit No.	Length, in days, of "Maturat'n Period."		Fruit No.	Length, in days, of "Maturat'n Period."	
	Plant A.	Plant B.		Plant A.	Plant B.		Plant A.	Plant B.		Plant A.	Plant B.		Plant A.	Plant B.
1	67	64	1	68	62	1	59	68	1	65	58	1	77	—
2	67	64	2	64	64	2	58	66	2	64	58	2	63	—
3	65	64	3	72	68	3	58	64	3	66	61	3	61	—
4	60	63	4	70	64	4	67	63	4	80	64	4	75	—
5	—	65	5	70	65	5	68	63	5	64	68	5	81	59
6	—	65	6	68	60	6	68	61	6	63	66	6	80	57
7	—	69	7	71	58	7	87	64	7	88	65	7	71	65
8	—	64	8	71	58	8	87	64	8	72	66	8	65	52
9	—	70	9	—	56	9	85	69	9	80	—	9	78	—
10	—	—	10	—	56	10	89	67	10	77	—	10	—	—
Average	65	65	Average	69	61	Average	72	65	Average	74	63	Average	72	58

As can be seen from the above table, the results obtained in 1925 are confirmed by plant A. but not by plant B. In the latter case the "maturation period" of all the fruits of the plant is nearly constant. This is interesting, and may be accounted for by the fact that this plant was abnormally strong and healthy.

The foregoing results are probably seen to better advantage in the accompanying diagrams (Figs. 1 and 2). In Fig. 1a, the sudden increase in the "maturation period," which was noted in 1925, is seen again in the third truss, fruits 7 to 10 and in the fourth truss, fruits 4 and 7 to 10.

Fig. 1b is interesting on account of the approaching constancy of the "maturation period." This is better seen in Fig. 2b. In this diagram, the "maturation period" set out previously in days, along the vertical arm, has been replaced by the actual dates of picking. The straight line A.B. represents the "maturation periods" of the fruits from a tomato plant, which ripened all its fruits in the same number of days. At the places where the graph comes above the line A.B., a retardation of the "maturation period" occurs, and where the graph comes below the line an acceleration of the period occurs. As can readily be seen, plant B. approaches very closely to the ideal.

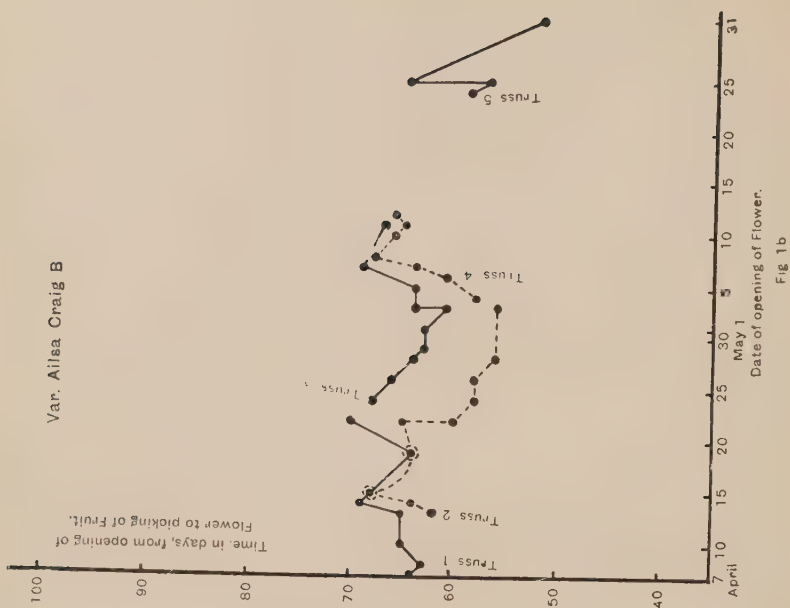
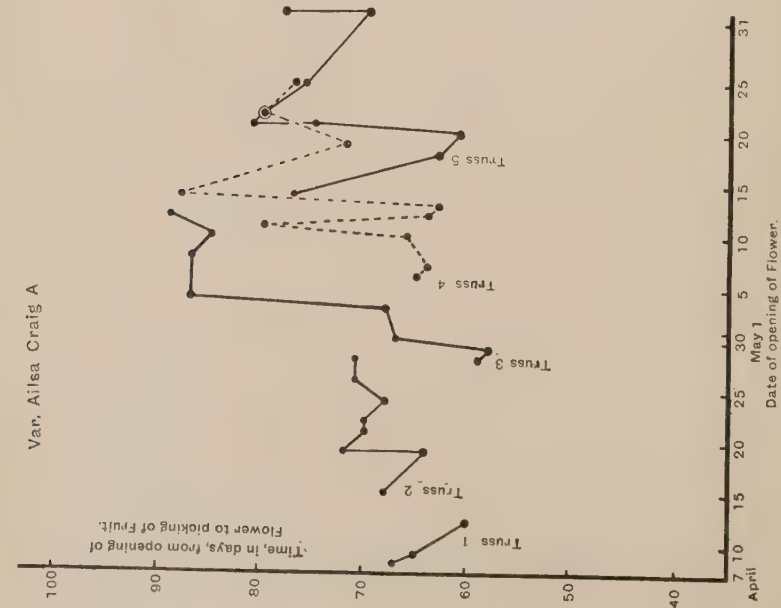
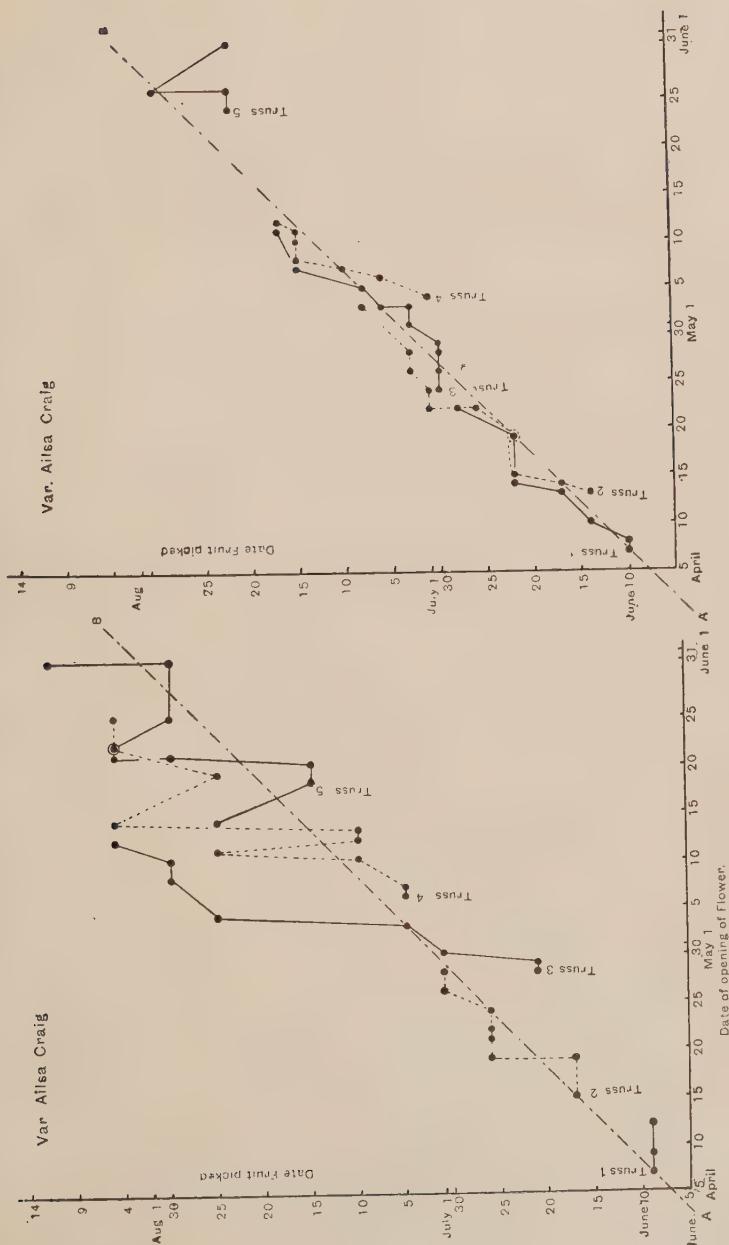


Fig 1b



Var. Manx Marvel
Potash withheld from
manurial treatment.

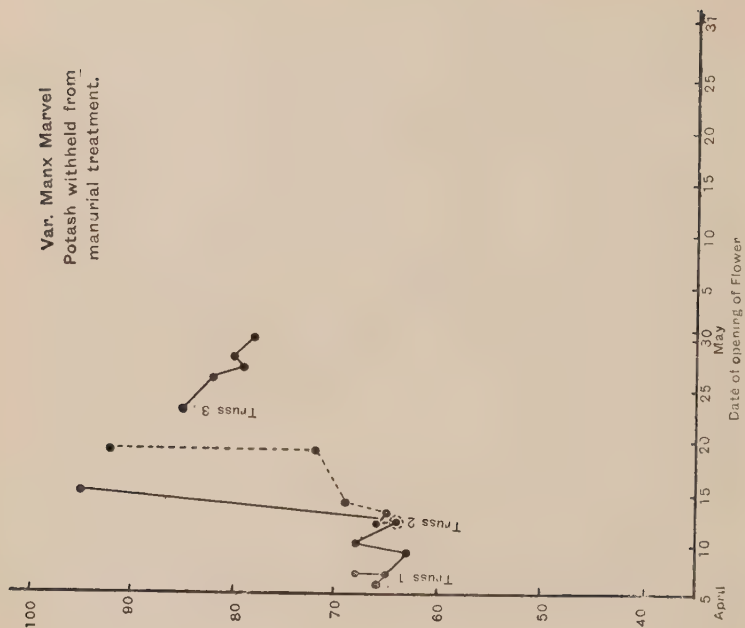


Fig. 3b

Var. Manx Marvel
Nitrogen withheld from
manurial treatment.

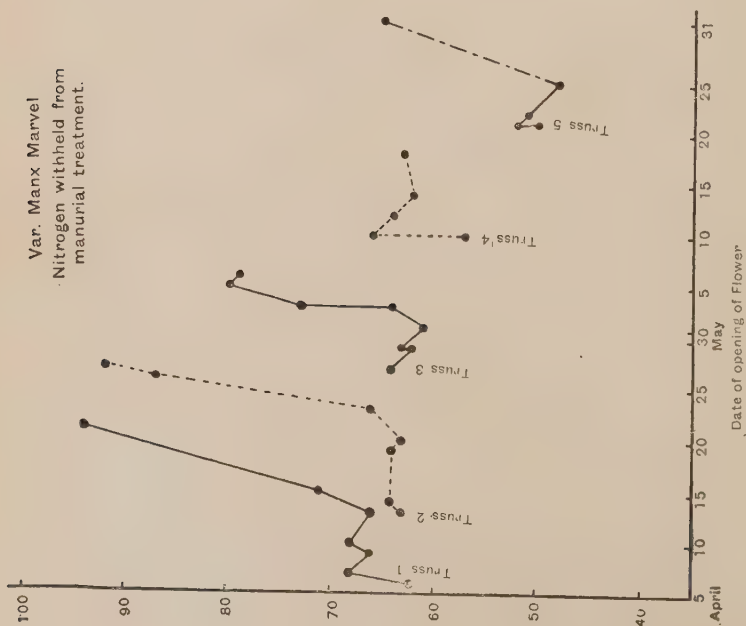


Fig. 3a

Fig. 2a illustrates clearly the retardation of the "maturation period" of the last few fruits of the third and fourth trusses, whilst truss 2 approaches the ideal as shewn by the line A.B.

The Effect of Manurial Treatment on the "Maturation Period."

To ascertain whether manurial treatment has any effect on the "maturation period," records were made on plants selected from the manurial experimental plots. These plants were situated in the plots from which nitrogen and potash respectively were withheld, and also in those plots receiving increasing amounts of nitrogen and potash in their manurial treatment.

A detailed analysis of the results obtained from the plants in the plots from which nitrogen and potash, respectively, were withheld, is given in Table 2, and the results are expressed diagrammatically in Figs. 3a and 3b.

It will be seen from a comparison of Figs. 3a and 3b that the "maturation period" is shortened when plants are growing in soil deficient in nitrogen, and is correspondingly lengthened when potash is withheld.

The records from those plants which received increasing amounts of nitrogen and potash respectively, suggest that the additions of nitrogenous fertilisers lengthen the "maturation period," which conversely is shortened by the addition of potash. The work will be repeated in 1927, when it may be possible to provide adequate proof of this assumption.

Table 2.

TRUSS 1.			TRUSS 2.			TRUSS 3.			TRUSS 4.			TRUSS 5.		
Fruit No.	Length, in days, of "Maturation Period."		Fruit No.	Length, in days, of "Maturation Period."		Fruit No.	Length, in days, of "Maturation Period."		Fruit No.	Length, in days, of "Maturation Period."		Fruit No.	Length, in days, of "Maturation Period."	
	No Nitro-gen.	No Pot-ash.		No Nitro-gen.	No Pot-ash.		No Nitro-gen.	No Pot-ash.		No Nitro-gen.	No Pot-ash.		No Nitro-gen.	No Pot-ash.
1	—	—	1	63	64	1	64	85	1	—	—	1	50	—
2	62	66	2	64	66	2	62	82	2	57	—	2	52	—
3	62	65	3	64	65	3	63	79	3	66	—	3	51	—
4	68	68	4	64	69	4	61	80	4	64	—	4	48	—
5	66	65	5	63	72	5	64	78	5	62	—	5	52	—
6	68	63	6	66	92	6	73	80	6	63	—	6	—	—
7	66	68	7	87	—	7	80	—	7	—	—	7	65	—
8	71	64	8	92	—	8	79	—	8	—	—	8	—	—
9	94	95	9	—	—	9	—	—	9	—	—	9	—	—
Average	70	70	Average	70	71	Average	68	81	Average	62	—	Average	53	—

Summary.

1. Observations, made in 1925, of the length of time between the opening of the flowers and the picking of the fruits of tomato plants, *i.e.*, the "maturation period," showed that the later fruits from the trusses of a tomato plant take a longer time to ripen than the first six or seven fruits. This lengthening of the "maturation period" is particularly noticeable in the second, third and fourth trusses.

2. Records made during the present season confirm the work of 1925, but in the case of an abnormally healthy plant all the fruits ripened in approximately the same number of days.

3. Fruits from plants growing in soil from which nitrogen has been withheld consistently during the last eleven years ripened more quickly than those from plants treated normally. Conversely the "maturation period" was lengthened when potash was withheld.

7. Chemical Investigations.

O. OWEN.

Soil Analysis.

As in former years a number of soils from commercial nurseries have been examined. In general, there is little to add to what has been written in previous reports. Land which has not been used for glasshouse cultivation as a rule lacks lime, but ordinary tomato soils contain an ample amount. A dressing of two tons of slaked lime per acre per annum is, therefore, always sufficient. Many growers are under the impression that the white granules which appear in soils consist of sulphate of lime. Miss H. G. Mitchell, of the Swanley Horticultural College, has kindly undertaken the analysis of these granules taken from a trade nursery, and finds that they consist almost entirely of calcium carbonate, so that when these granules appear there is no shortage of lime. In these circumstances no fear of sourness need be apprehended, and the annual dressing of lime can be kept as low as possible.

At the end of the growing season samples of all the tomato experimental plots at the Station were analysed for carbonates, which is the form in which lime is generally present.

In the old block (series G. to M.), except in the first year, the annual dressing of lime has never exceeded 2 tons per acre.

In the series N., O. and P., an annual dressing of 2 tons per acre has been given since 1924. Some good crops have been obtained in these houses, and there is no shortage of lime. House Q. has never been limed, and even here only three of the plots are sour.

While it is difficult to obtain representative samples from the plots, it is clear that none of the plots (except in Q.) is deficient in lime. In G. the percentage of total carbonates varied from 1.37 to 3.36; in house H. from 2.11 to 3.02; in J. from 1.88 to 4.24; in K. from 1.83 to 4.17; in M. from 0.78 to 1.79; in N. from 0.60 to 0.94; in P. from 0.66 to 1.31; and in O. from 0.45 to 0.89.

The Amount of Potash, Phosphoric Acid and Nitrogen Removed by Tomato Plants.

The work described last year under this heading has been repeated in detail. Last year, the chief conclusion was that the amount of phosphoric acid removed by a crop of tomatoes was very small compared with the amounts of potash and nitrogen removed. The proportions of the three substances in the complete crop in a manured plot in 1925 were :—

8.98 potash, 1 phosphoric acid, 4.59 nitrogen.

In another house, and in a season in which growing conditions have been different, these figures have, in the main, been confirmed in 1926.

A number of points of interest arose out of the 1925 results, and these were deemed worthy of attention in 1926. Among these were :—

1. How do the amounts of nutrient substances taken up by the plant vary month by month?
2. Does the composition of the plant vary with its age?
3. Do the trusses at different parts of the plant have the same composition?

In an attempt to answer these questions two rows of twenty plants each of the variety Manx Marvel were grown in house M., which has been regularly manured during several years, and which was steamed in the winter, 1923-24. The plants were labelled in eight groups of five, *e.g.*, 1a, 1b, 1c, 1d, 1e, 2a, 2b, and so on.

The plants lettered a, b and c in each group were to be analysed whilst the d and e plants in each group were the "reserves," to be used in case of accidents to the a, b, c, plants.

The plants were planted on March 5th, 1926, and were then treated in the usual commercial manner. All the trimmings from each plant were taken to the laboratory, weighed and kept for analysis. The fruit from each truss of each plant was picked when ripe, and each truss was weighed and analysed as a whole.

At the end of the first month of growth, the plants 1a, 1b and 1c were cut just above the soil surface and brought to the laboratory for analysis. Similarly, at the end of the second month of growth, the three plants in group marked 2 were cut and brought in for analysis, and so for the other plants. Owing to the coal shortage, it was difficult to keep the plants in good condition during September, so at the end of that month plants in groups 7 and 8 were cut out instead of allowing group 8 to go on till the end of the eighth month (October).

As a result of the work we have analysed plants which had grown for periods ranging from one to seven months after planting out and the analysis of different trusses on such plants.

The green weights of plant and fruit (if any) are shown in Table 1 and the corresponding dry weights in Table 2.

Table 1.
Total Green Weights (in Grams.).

No.	Green Parts.	Fruit.	Total.	Average.
1a	43.5		43.5	} 44.8
1b	50.0		50.0	
1c	40.8		40.8	
2a	417.2		417.2	} 326.0
2b	249.3		249.3	
2c	310.7		310.7	
3a	575.5	414.0	989.5	} 1281.0
3b	633.0	320.0	953.0	
3c	956.9	942.0	1898.9	
4a	940.0	1533.0	2473.0	} 2149.0
4b	826.0	875.0	1701.0	
4c	912.0	1359.0	2272.0	
5a	1946.7	2056.4	4003.1	} 4566.0
5b	2325.2	2135.0	4460.2	
5c	1982.3	3251.5	5263.8	
6a	2310.5	1896.5	4207.0	} 3892.0
6b	2064.5	1944.1	4008.6	
6c	1240.0	2219.5	3459.5	
7a	1687.7	3331.8	5019.5	} 4215.0
7b	1273.5	3115.4	4388.9	
7c	2568.0	1779.0	4347.0	
8a	966.5	2466.8	3433.3	}
8b	1600.0	3234.6	4834.6	
8c	1355.5	1930.6	3266.1	

Table 2.
Total Dry Weights (in Grams.).

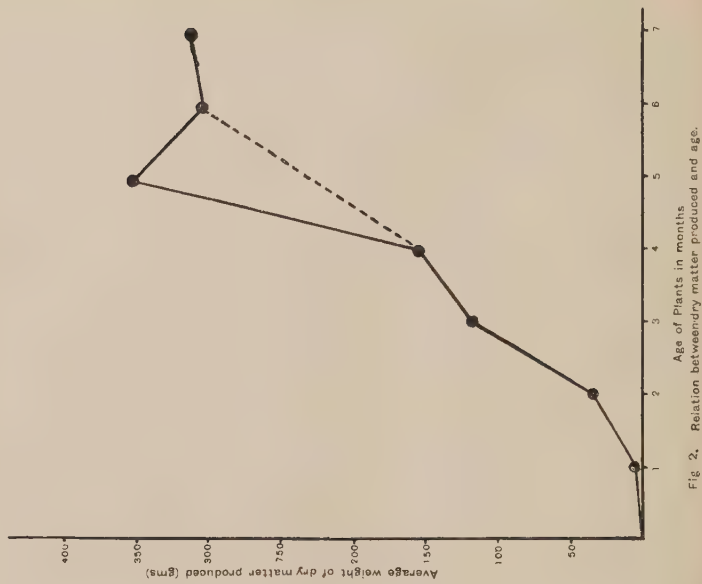
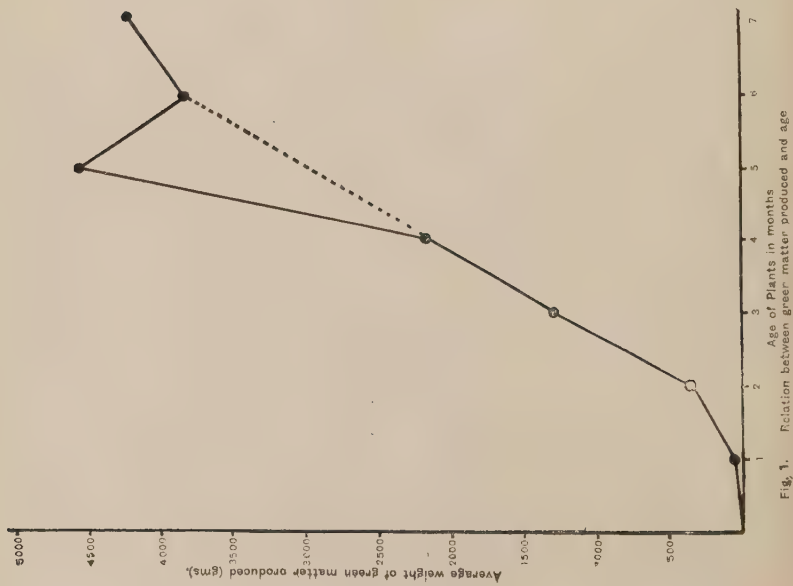
No.	Green Parts.	Fruit.	Total.	Average.
1	4.24		4.24	4.24
2a	33.48		33.48	} 34.42
2b	29.54		29.54	
2c	40.23		40.23	
3a	59.05	25.27	84.32	} 117.5
3b	105.4	23.12	128.52	
3c	86.25	53.45	139.70	
4a	89.54	71.45	160.99	} 155.1
4b	81.68	57.67	139.35	
4c	96.63	68.18	164.81	
5a	175.5	102.96	278.46	} 351.5
5b	305.5	123.26	428.76	
5c	184.0	163.31	347.31	
6a	252.7	92.52	345.22	} 305.2
6b	199.5	123.63	323.13	
6c	138.8	109.42	247.22	
7a	182.7	159.54	342.24	} 312.2
7b	140.2	158.89	299.09	
7c	237.5	89.24	326.74	
8a	157.7	141.74	299.44	}
8b	199.6	147.31	346.91	
8c	158.0	100.48	258.48	

It will be observed that figures for the fifth month are the highest. This is due to the fact that the plants in this group were abnormally good. It is well known that in almost any house individual plants stand out as having an exceptional development and the fruit from such plants is often kept for seed. Such was the case with the plants in question. The amount of fruit and green matter produced was out of all proportion to that of the other plants examined.

From Table 2 we find that the average dry weight per plant produced in each month is as shown in Table 3.

Table 3.

First	month (March)	...	...	4.24	gms.
Second	„ (April)	...	...	30.18	„
Third	„ (May)	...	...	83.08	„
Fourth	„ (June)	...	...	37.6	„
Fifth	„ (July)	}	...	150.1	„
Sixth	„ (August)		...		
Seventh	„ (September)	...	...	36.8	„



These figures show that there is a decided increase in the rate of growth during the month of May, and another spurt between the end of June and the end of August. It should be mentioned that the first watering was given on May 14th, and the first top dressing on May 21st. With one or two exceptions the plants were stopped at five trusses by May 27th. Swelling of the lower two trusses was soon noticed and by the middle of June all the first four trusses had set. The check due to stopping is probably reflected in the reduction in the rate of growth shown in June. During July and August the side shoot and "top" generally was making headway, and this is reflected in the high figure shown for those two months.

The rates at which green matter and dry matter respectively, are produced are shown in the curves in Figs. 1 and 2. The dotted lines in each figure represent the course of growth if plants in group 5 are omitted.

Turning to the figures shown by analysis of the plants, they seem to afford little significant information. To economise space the average values for three plants are given in Tables 4 to 7 which are self-explanatory. The fruit on plants No. 3 was entirely green. On plants No. 4 some of the fruit had begun to ripen whilst most of that on plants 6, 7 and 8 was fully ripe. The average figures for the ripe fruit suggest that in the case of potash and phosphoric acid the third truss contains the highest proportion.

Table 4.

Average Percentage Ash in the Dry Matter of the Trusses.

Plant No.	Trusses.								
	1	2	3	4	5	6	7	8	9
3	11.26	12.21	12.51						
4	11.87	12.57	12.27	11.87					
6	13.83	12.84	14.67	15.14	14.25	13.46	10.51		
7	12.29	13.74	12.89	13.53	12.20	11.22	12.04	10.68	10.44
8	10.98	11.28	13.91	13.29	12.55	12.34	12.54	12.60	

Table 5.

Average Percentage Nitrogen in the Dry Matter of the Trusses.

Plant No.	Trusses.								
	1	2	3	4	5	6	7	8	9
3	3.05	3.29	3.08						
4	2.65	3.13	2.75	3.02					
6	3.13	2.98	3.61	3.53	3.33	3.63	3.21		
7	3.08	3.34	3.18	3.40	3.35	3.16	3.42	2.69	2.94
8	2.77	3.28	3.53	3.23	3.64	3.45	3.18	3.41	
Average for ripe fruit ...	3.10	3.20	3.44	3.41	3.46	3.41	3.28		

From the third truss upwards the percentage of phosphoric acid per average truss decreases as the height of the truss increases. Such a gradation does not occur in the case of potash, in fact, after a drop in the value at the fifth truss, the percentage increases in the sixth and seventh trusses.

The nitrogen results show an increase up to the third truss. The percentage then remains reasonably the same to the sixth truss and falls somewhat in the seventh.

Table 6.Average Percentage Potash (K_2O) in Dry Matter of the Trusses.

Plant No.	Trusses.								
	1	2	3	4	5	6	7	8	9
3	6.68	7.02	8.65						
4	5.68	6.87	6.43	6.34					
6	6.41	7.59	7.88	6.69	5.71	6.18	5.64		
7	6.50	7.05	6.44	7.33	6.74	6.69	6.77	5.76	5.87
8	5.70	6.18	7.61	7.15	5.94	6.43	6.69	6.90	
Average for ripe fruit ...	6.21	6.60	7.42	7.28	6.13	6.47	6.72		

Table 7.Average Percentage Phosphoric Acid (P_2O_5) in Dry Matter of Trusses.

Plant No.	Trusses.								
	1	2	3	4	5	6	7	8	9
3	.69	.97	1.08						
4	.79	.80	.87	.84					
6	.97	.90	1.14	.98	.92	.88	.96		
7	.89	.90	.94	1.00	.97	.79	.85	.66	.82
8	.78	.79	1.09	.94	.84	.78	.79	.75	
Average for ripe fruit ...	.88	.86	1.05	.96	.91	.81	.82		

As might be expected the degree of ripeness affects the percentages of nitrogen, potash and phosphoric acid. If the plants 3 and 4 are considered it appears that the percentages increase as the plant is ascended. Naturally, where ripening is incomplete, the lowest truss will be the least unripe. It is quite possible that the *amounts* of nitrogen, potash and phosphoric acid respectively are the same in the early stages of fruit formation, but that as ripening proceeds more water is taken up and organic compounds are formed so that the *percentages* of the inorganic substances fall. Tables 8 to 10 give the ratio potash/nitrogen, potash/phosphoric acid, and nitrogen/phosphoric acid respectively.

Table 8.

Ratio Potash/Nitrogen in Fruit and Green Parts.

Plant No.	Trusses.									Green Parts.
	1	2	3	4	5	6	7	8	9	
1										2.17
2										2.00
3	2.30	2.13	2.81							2.31
4	2.14	2.23	2.35	2.13						1.80
6	2.07	2.23	2.20	1.90	1.69	1.70	1.76			1.93
7	1.92	2.16	2.02	2.19	2.03	2.12	2.04	2.14	2.00	2.15
8	2.20	1.90	2.16	2.15	1.65	1.70	2.10	2.03		2.03
Average for Ripe Fruit	2.06	2.09	2.13	2.08	1.96	2.14				

Table 9.

Ratio Potash/Phosphoric Acid in Fruit in Green Parts.

Plant No.	Trusses.									Green Parts.
	1	2	3	4	5	6	7	8	9	
1										10.60
2										10.07
3	9.62	7.26	8.01							11.44
4	7.43	8.91	7.40	7.71						11.45
6	6.66	7.27	7.14	7.05	7.04	7.24	5.88			8.71
7	7.32	6.83	6.89	7.33	6.92	8.76	8.28	8.73	7.16	10.74
8	7.34	8.17	7.30	7.64	7.10	8.29	8.53	9.00		9.10
Average for Ripe Fruit	7.11	7.42	7.09	7.34	7.02	7.89	8.77			

Table 10.

Ratio Nitrogen/Phosphoric Acid in Fruit and Green Parts.

Plant No.	Trusses.									Green Parts.
	1	2	3	4	5	6	7	8	9	
1										4.89
2										5.10
3	3.93	3.41	2.85							5.07
4	3.45	3.89	3.15	3.88						6.39
6	3.23	3.33	3.24	3.88	3.79	4.28	3.34			4.45
7	3.94	3.72	3.43	3.42	3.78	3.94	4.05	4.71	3.59	5.00
8	3.58	4.27	3.36	3.52	4.34	4.45	4.04	4.59		4.69
Average for Ripe Fruit	3.56	3.77	3.34	3.61	3.86	4.07	4.08			

The values for the individual trusses and the averages for ripe fruit are exceedingly irregular and apparently have no significance.

Table 11 shows the average analysis of the green parts of the different plants. Here the outstanding feature is that the plants 1 show high percentages compared with the other plants. This fact has often been observed with young tomato plants. It is difficult to understand why the green parts of a plant grown in a 60-pot, or which has been planted out for a few weeks, should be richer than those of a plant which has grown longer but which has not borne any appreciable amount of fruit.

The total amounts ratios of materials extracted by the different plants are shown in Table 12.

A feature of this table is the amounts removed by plants 7 and 8 as compared with 6.

Table 11.
Average Analysis of Dry Matter of Green Parts (%).

Plant.	Ash.	Nitrogen.	Potash.	P ₂ O ₅
1	22.46	3.65	7.91	.746
2	21.32	3.382	6.74	.672
3	20.68	2.892	6.62	.579
4	24.08	3.797	6.21	.550
6	23.84	3.109	6.05	.718
7	25.22	2.838	6.10	.571
8	21.65	2.772	5.61	.618

Despite their higher weight, 7 and 8 have actually extracted less material than 6, although they remained alive for one month longer.

Finally it will be seen that for reasonably mature plants the proportions removed are :

7.6—9.2	... Potash.
1	... Phosphoric Acid.
4.06—4.10	... Nitrogen.

These last figures again raise the question : Why do we use so much phosphate in our fertilisers ? The results on the experimental plots show that the omission of phosphates has little effect on the quality or the quantity of the fruit. The analyses which are now given show that the proportion of phosphates the plants actually use is small. It now remains to be seen whether phosphates have any decided effects on those changes which produce plant food in the soil. This last point will be investigated in 1927.

Table 12.
Summary of Totals.

Plant.	Total K ₂ O gms.	Total P ₂ O ₅ gms.	Total N gms.	Relative			
				K ₂ O	P ₂ O ₅	N	K ₂ O
							N
1	.335	.032	.154	10.47	1	4.81	2.18
2	2.338	.232	1.163	10.08	1	5.01	2.01
3	7.733	.762	3.654	10.15	1	4.80	2.12
4	10.197	1.091	4.685	9.35	1	4.29	2.18
5	22.843	2.757	11.862	8.29	1	4.30	1.93
6	19.149	2.510	10.184	7.63	1	4.06	1.88
7	21.310	2.312	9.610	9.22	1	4.16	2.22
8	18.295	2.183	8.960	8.38	1	4.10	2.04

8. The Effect of Grass Cuttings on Soil Bacteria.

T. SMALL.

The experiments in tomato houses N., O., P. and Q. indicated that the addition of grass cuttings to the soil causes an increased crop, and it seemed possible that this increased fertility is due to greater bacterial activity in the soil. The following investigation was suggested by the Director to ascertain if the addition of grass and allied material influences the number of bacteria in the soil.

Collection and Preparation of the Material.

The soil used in these experiments was obtained from an experimental plot in house Q. which has remained unmanured and fallow since the erection of the glasshouse in 1923. The soil immediately below the surface was dug and put through a clean 3 m.m. sieve. The moisture content of the soil is given in the tables on p. 90.

Moist grass was obtained from a field adjoining the nursery, and was cut into pieces about one inch long. In series B., where hay was used, grass from the same field was allowed to dry in the laboratory, and when ready was cut into small pieces. The moisture content of the grass and hay is given in the tables on p. 91.

The various mixtures were prepared as quickly as possible after the collection of the material, and were put into clean dry bottles of 3 litres capacity. The bottles were plugged with cotton wool and left in a cool place under the laboratory bench.

The mixtures used are summarised in Table 1.

Table 1.

Series.	Date Commenced.	No. of Bottles.	Grams of Soil per Bottle.	Grams of Grass per Bottle.	Grams of Hay per Bottle.	Sterile Water per Bottle.
A	3.3.26	1	500	—	—	—
	"	1	250	50	—	—
	"	1	—	75	—	—
B	13.5.26	7	500	—	—	—
	"	7	500	100	—	—
	"	7	500	—	26	—
	"	7	500	—	26	74 ccs.
	"	3	—	100	—	—

The determination of the Bacterial Numbers.

The number of bacteria in the mixtures was determined at convenient intervals by the following method.

After thoroughly shaking the material in the bottle a sample was withdrawn as quickly as possible and placed in a weighed, plugged, sterile, specimen tube. 5.0 grams of this sample were transferred to 500 ccs. of sterile water contained in a litre flask, and after shaking vigorously for five minutes, 1 cc. of the muddy suspension was transferred to 99 ccs. of sterile water. This was well shaken, and 1 cc. transferred to a second 99 ccs. of sterile water. 1 cc. of this final dilution was transferred to a sterile petri dish and the melted, cooled agar medium added in the usual way. The petri dish was agitated a little to distribute the bacteria. Thornton's medium was used, and all the media required for any one series was made at once so that the Ph. value was the same for each determination.

The petri dishes were incubated during eight days at 20° C., and the bacterial colonies then counted. Counts were made with the naked eye and with the aid of a plate counter. The removal of the petri dish lid during counting assisted in the detection of fungal colonies.

Five plates were used for each determination. In order to make counting possible, the dilutions had to be modified from time to time. Throughout the process of sampling and preparing the dilutions, aseptic precautions were observed. Whenever a sample

was taken for a bacterial count, another was used to determine the moisture content. This material was air-dried, and the percentage moisture content given in Tables 2 and 3 is based upon the wet weight of the original material.

The number of bacteria per gram of air-dried material was calculated from the foregoing data.

Whereas in series A. the samples used for each determination were taken from the same bottle, in series B. a fresh bottle was taken each time, and the remainder of the material was used for the determination of ammonia. These determinations were made by the station chemist. The results of these experiments are summarised in Tables 2 and 3 and show that:—

- (a) The addition of grass or hay to the soil leads to an increase in the number of bacteria present; hay being most effective.
- (b) The number of bacteria in the soil alone remained approximately constant, while in all cases of mixtures the number of bacteria rose to a maximum and then decreased.
- (c) More ammonia was produced in the grass than in the soil.

Table 2, Series A.

No. of Sample.	Date of Sample.	Soil only.		Soil and Grass.		Grass only.	
		Bacteria.	Moisture Content.	Bacteria.	Moisture Content.	Bacteria.	Moisture Content.
1	3.3.26	16.43	14.0%	149.8	24.4%	214.6	80.2%
2	12.3.26	15.86	13.0%	257.1	23.6%	1,217.0	80.7%
3	22.3.26	9.56	14.2%	225.9	24.4%	—	82.2%
4	31.3.26	16.14	15.1%	110.3	25.1%	—	—
5	9.4.26	16.10	15.2%	176.6	26.9%		
6	19.4.26	14.68	14.8%	118.1	27.2%		
7	29.4.26	12.7	15.1%	36.5	27.3%		

The number of bacteria is given in millions per gram of air-dried soil.

Table 3, Series B.

No. of Sample	Date of Sample	Soil Only			Soil and Grass			Grass only			Soil and Hay			Soil, Hay and Water	
		†Bacteria	Moisture Content	*Nitrogen as Ammonia	Bacteria	Moisture Content	Nitrogen as Ammonia	Bacteria	Moisture Content	Nitrogen as Ammonia	Bacteria	Moisture Content	Nitrogen as Ammonia	Bacteria	Moisture Content
1	13.5.26	10.81	15.35%	—	34.90	26.00%	—	386.4	77.40%	—	15.67	16.65%	—	—	—
2	22.5.26	19.06	16.10%	56.90	155.20	26.55%	136.80	—	—	—	†	12.60%	382.6	†	23.25%
3	2.6.26	16.81	14.75%	34.02	181.20	30.45%	111.90	86,660.0	80.09%	6573.0	80,715.0	12.50%	477.5	23,290.0	24.25%
4	9.6.26	12.95	15.00%	54.59	111.90	24.34%	90.51	276,300.0	76.76%	5320.0	128,100.0	12.88%	623.8	41,850.0	28.88%
5	15.7.26	9.19	13.00%	—	74.23	24.80%	—	—	—	—	60,940.0	10.40%	—	46,450.0	25.30%
6	26.7.26	9.20	13.10%	98.68	45.05	24.50%	150.10	—	—	—	3,612.0	10.00%	308.0	2,024.0	23.20%
7	4.8.26	11.87	13.00%	38.89	51.45	20.90%	45.72	—	—	—	530.8	9.80%	509.0	230.9	22.70%

† The number of bacteria is given in millions per gram of air-dried soil.

* The Ammonia is given in parts per million of dry soil.

† Too numerous to count.

9. Some Experiments with Tomatoes in Seedboxes.

A. A. RICHARDS.

The following experiments were begun two years ago, to determine the best compost for raising tomato seedlings and young plants.

As an unlimited supply of fresh turf is not available at the Station, and the funds at our disposal do not permit the purchase of this material, it is necessary to use old cucumber beds for propagation purposes.

This material is sterilised by baking in a small oven for twenty-four hours, and is kept under cover until used. Many nurserymen have to practise similar economies and therefore baked cucumber beds were used as a basis for these experiments.

A large number of fertilisers were tested as well as mechanical mixtures depending upon the addition of such materials as dried clay, ashes and gravel.

The composts were prepared and carefully mixed. Two boxes were filled with each compost. The seeds were sown at the rate of forty-five seeds per box, and treated in the usual nursery manner. Careful records were taken and the results are given in the following table.

Explanation of Signs used in the following Table :—

*	...	...	Germinated, but little further growth.
**	...	...	Small seedlings with two dark green cotyledons.
***	...	...	Normal seedlings.
*** S	...	...	Normal seedlings inclined to softness.
****	...	...	Very good seedlings.
**** S	...	...	Very good seedlings inclined to softness.
*****	...	...	Best seedlings of all. Very sturdy.
†	...	...	Number of seeds which germinated not counted.

No.	Treatment.			Germination Type of No. of seeds Seedling, out of 45.		Leaves,	Stems,	Remarks.
1	Sand only	...	...	...	...	Pale green ...	Purple at base. Smooth.	The seedlings were hard in the higher percentages of sand, and the compost dried out too quickly. The percentage of sand should not exceed 25.
2	7500 parts Sand.	...	...	42	***	Bright green	Green. Very hairy ...	
3	5000 "	...	...	43	***	" "	Pale green. Purple at base. Hairy ...	
4	2500 "	...	...	44	*****	" "	Pale purple green. Hairy ...	
5	1000 "	...	...	44	*****	" "	Pale green. Purple at base. Hairy ...	
6	Clay only	...	...	39	**	Dark green ...	Spindly. Purple. Small hairs ...	The seedlings were hard and backward in pure clay, but the lower percentages of clay counteracted the open nature of the baked soil. 25% clay in the compost gave the best seedlings in the whole of the experiments.
7	7500 parts Clay.	...	...	45	***	Bright green	Pale green. Purple at base. Hairy ...	
8	5000 "	...	...	43	*****	" "	Purple green. Hairy ...	
9	2500 "	...	...	44	*****	" "	Pale green. Hairy ...	
10	Clay only	...	...	38	**	Dark green ...	Thin, dark green ...	
11	7500 parts Clay.	...	...	40	***	Bright green	Bright green. Purple. Hairy ...	The effect of adding gravel to baked soil was beneficial. Gravel alone required frequent watering and the seedlings were soft in consequence.
12	5000 "	...	...	40	*****	" "	" "	
13	2500 "	...	...	44	*****	" "	Pale green. Hairy ...	
14	Gravel only	...	...	43	**	Pale green ...	Purple green. Slightly hairy	
15	7500 parts Gravel.	...	...	44	***	" "	Purple at base. ... Hairy	
16	5000 "	...	...	41	***	" "	Green. Hairy ...	The effect of adding gravel to baked soil was beneficial. Gravel alone required frequent watering and the seedlings were soft in consequence.
17	2500 "	...	...	42	***	Bright green	Green. Hairy ...	
18	Gravel only	...	...	40	***	Pale green ...	Pale green. Slightly hairy	
19	7500 parts Gravel.	...	...	37	*** S	Pale green, inclined to softness	Pale green. ... Slightly hairy	
20	5000 "	...	...	40	***	Green	Green. Hairy ...	
21	2500 "	...	...	43	***	Bright green	Purple green. Hairy	

No.	Treatment.	Germination Type of No. of seeds Seedling. out of 45.	Leaves.	Stems.	Remarks.
22	Sterilised Soil only	43	***	Purple green.	The addition of virgin soil to the baked soil was beneficial, but there is grave risk of introducing disease by this process.
23	7500 parts Sterilised Soil.	44	*** S	Very thick, hairy, pale	
24	5000 "	42	*** S	Bright green in- clined to softness	
25	2500 "	43	***	Bright green	
26	Sterilised Soil only	43	***	"	
27	7500 parts Ashes.	38	**	Pale green ...	
28	5000 "	42	***	"	
29	2500 "	43	***	Bright green	
30	500 "	42	***	"	
31	Ashes only	43	***	Pale green.	The addition of ashes increased the need for watering, and gave soft seed- lings.
32	7500 parts Ashes.	37	*** S	"	
33	5000 "	37	*** S	"	
34	2500 "	41	*** S	Bright green	
35	2500 parts Lime.	19	*	Pale green and blotchy	Tomato seedlings re- quire but little lime in the compost. Above 0.3 per cent. added, the growth became hard.
36	1000 "	38	**	"	
37	500 "	32	**	"	
38	100 "	45	**	Pale green	
39	50 "	42	**	"	
40	30 "	45	**	"	
41	10 "	44	**	"	
42	100 "	42	**	Bright green	
43	10 "	42	**	Pale green	
44	5 "	43	**	Normal green	
			"	"	

No.	Treatment.	Germination No. of seeds out of 45.	Type of Seedling.	Leaves.	Stems.	Remarks.
45	5000 parts Charcoal.	42	**	Small, dark ...	Small, dark ...	The addition of charcoal gave large, soft seedlings. The addition of stable manure above 10 per cent. resulted in soft growth.
46	2000 "	45	**** S	Pale, soft ...	Thick, soft ...	
47	500 "	42	**** S	" " "	" " "	
48	3300 parts Stable Manure.	42	**** S	Bright green	Hairy ...	
49	2500 "	44	**** S	" " "	Very hairy ...	
50	1600 "	42	**** S	" " "	" " "	
51	1000 "	42	****	Bright green inclined to softness	" " "	
52	1000 parts Bone Meal.	None	—	—	—	Few seeds germinated, cotyledons did not develop, seedlings died. Harmful effect.
53	500 "	21	—	—	—	
54	100 "	45	**	Pale yellow with dark blotches	Spindly, purple green. Hairy, hairs short ...	
55	50 "	43	**	Small, dark ...	Thin and hard	
56	25 "	42	**	" " "	" " "	
57	10 "	45	**	" " "	" " "	
58	1000 parts Bone Flour.	40	*	Deep green. Yellow blotches	Spindly. Purple green. Hairy, hairs short ...	Above 0.25 per cent. the effect of Bone Flour was harmful.
59	500 "	43	**	" " "	Purple green. Hairy, hairs short ...	
60	100 "	42	**	" " "	" " "	
61	50 "	44	****	" " "	" " "	
62	25 "	45	****	Normal green	Green ...	
63	10 "	43	****	" " "	" " "	
64	1000 parts Hoof and Horn.	†	*	—	—	Little growth after germination. Germination bad. No growth after initial stages. Seedlings died. Above 0.05 per cent. Hoof and Horn was harmful.
65	500 "	—	—	—	—	
66	100 "	15	*	Deep green ...	Purple ...	
67	50 "	†	*	" " "	" " "	
68	30 "	†	*	" " "	" " "	
69	10 "	†	****	" " "	" " "	
70	5 "	†	****	" " "	" " "	
71	10 "	44	****	" " "	" " "	
72	5 "	40	**** S	Normal	Thick, good	
73	1 "	42	****	" " "	" " "	

No.	Treatment.		Germination No. of seeds out of 45.		Leaves.	Stems.	Remarks.
74	1000 parts Dried Blood.	9000 parts Sterilised Soil	—	—	—	—	
75	500 "	9500 "	—	—	—	—	
76	100 "	9900 "	29	—	—	—	
77	50 "	9950 "	†	Deep green ...	Purple ...	...	No advantage from low concentrations. Harmful above 0.05%.
78	30 "	9970 "	†	" " " "	" " " "	...	
79	10 "	9990 "	†	" " " "	" " " "	...	
80	5 "	9995 "	†	" " " "	" " " "	...	
81	10 "	9990 "	40	Dark green ...	Thick	...	
82	5 "	9995 "	42	" " " "	" " " "	...	
83	1 "	9999 "	41	Normal	Normal	...	
84	1000 parts Fish Manure.	9000 parts Sterilised Soil	—	—	—	—	
85	500 "	9500 "	—	—	—	—	
86	100 "	9900 "	30	Very hard	Purple, hairy	...	Fish manure was harmful in high concentration but at 0.1% good seedlings were obtained. They were the best of those treated with artificials.
87	50 "	9950 "	†	Deep green ...	Purple green	...	
88	30 "	9970 "	†	" " " "	" " " "	...	
89	10 "	9990 "	†	Bright green	Bright green	...	
90	5 "	9995 "	†	" " " "	" " " "	...	
91	10 "	9990 "	43	" " " "	" " " "	...	
92	5 "	9995 "	40	" " " "	" " " "	...	
93	1 "	9999 "	45	Pale green ...	" " " "	...	
				" " " "	" " " "	...	
				" " " "	" " " "	...	
94	1000 parts Guano.	9000 parts Sterilised Soil	—	—	—	—	
95	500 "	9500 "	—	—	—	—	
96	100 "	9900 "	—	—	—	—	
97	50 "	9950 "	†	Deep green ...	Purple green	...	Unsatisfactory.
98	30 "	9970 "	†	" " " "	" " " "	...	
99	10 "	9990 "	†	" " " "	" " " "	...	
100	5 "	9995 "	†	" " " "	" " " "	...	
101	10 "	9990 "	42	" " " "	" " " "	...	
102	5 "	9995 "	45	" " " "	" " " "	...	
103	1 "	9999 "	44	Normal	Normal	...	

No.	Treatment.	No. of seeds out of 45.	Germination Type of Seedling.	Leaves.	Stems.	Remarks.
104	50 parts Sulphate of Potash. 9950 pts. Sterilised Soil	40	**	Deep green ...	Purple green. Hairy, hairs small ...	Harmful above 0.05%.
105	30 "	43	**	"	"	
106	10 "	44	***	Very pale ...	Moderately hairy	
107	5 "	—	All seedlings damped off	—	—	
108	10 "	43	**	Deep green ...	Purple, hairy ...	Basic Slag was harmful above 1 per cent. Good seedlings were obtained with the lower concentrations.
109	5 "	42	****	Dark green ...	"	
110	1 "	42	****	"	"	
				"	"	
111	1000 parts Basic Slag. 9000 parts Sterilised Soil ...	41	**	Blotchy yellow	Spindly. Purple	Basic Slag was harmful above 1 per cent. Good seedlings were obtained with the lower concentrations.
112	500 "	40	**	"	Purple green. Hairs short. Purple at base	
113	100 "	41	***	Deep green ...	Hairy, hairs short ...	
114	50 "	42	****	Normal green	Normal	
115	25 "	43	****	"	"	Phosphates were less harmful than other artificials and in low concentrations gave large soft seedlings.
116	10 "	43	****	"	"	
				"	"	
				"	"	
117	1000 parts Superphosphate. 9000 parts Sterilised Soil	41	*	Bright green	Purple green. Hairy, hairs short ...	Phosphates were less harmful than other artificials and in low concentrations gave large soft seedlings.
118	500 "	40	** S	Pale green ...	Pale green. Moderately hairy	
119	100 "	45	**	"	"	
120	50 "	43	**** S	Large, pale green	Thick, soft	
121	25 "	44	**** S	"	"	Phosphates were less harmful than other artificials and in low concentrations gave large soft seedlings.
122	10 "	43	**** S	"	"	

No.	Treatment.		Germination No. of seeds out of 45.	Type of Seedling.	Leaves.	Stems.		Remarks.
123	50 pts.	Ammonium Sulphate	9950	pts. Sterilised Soil	*	Very blotchy	Spindly. Dark. Hairs short ...	
124	30 "	"	9970	" "	*	"	" "	
125	10 "	"	9990	" "	**	Dark green blotched	" "	
126	5 "	"	9995	" "	***	Dark green. Hard	Dark green. Hairy ...	Unsuitable.
127	10 "	"	9990	" "	—	—	—	
128	5 "	"	9995	" "	—	—	—	
129	1 "	"	9999	" "	****	Large, dark green	Normal ...	
130	50 parts	Sodium Nitrate.	9950	parts Sterilised Soil	*	Dark green ...	Purple ...	
131	25 "	"	9975	" "	**	" "	Purple green. hairy, hairs short ...	Mod.
132	10 "	"	9990	" "	***	" "	Purple green. Moder- ately hairy	
133	5 "	"	9995	" "	*** S	" "	Pale green. Hairy, hairs long ...	Harmful above 0.1%. Below 0.05 % gave large soft seedlings.
134	10 "	"	9990	" "	—	—	—	
135	5 "	"	9995	" "	****	Dark green ...	Purple green, hairy ...	
136	1 "	"	9999	" "	*****	" "	" "	
137	50 parts	Potassium Nitrate.	9950	pts. Sterilised Soil	**	Dark green ...	Purple green. Hairs short ...	
138	30 "	"	9970	" "	**	"	" "	
139	10 "	"	9990	" "	**	"	" "	
140	5 "	"	9995	" "	**	"	" "	
141	10 "	"	9990	" "	**	"	" "	
142	5 "	"	9995	" "	—	—	—	Unsuitable.
143	1 "	"	9999	" "	***	"	" "	
					***	Smaller than normal	" "	

No.	Treatment.		Germination No. of seeds out of 45.		Type of Seedling.	Leaves,	Stems,	Remarks.
144	50 parts	Ammonium Nitrate	9950 pts.	Sterilised Soil	*	Dark green ...	Purple green. short ...	Hairs ...
145	30 "	"	9970	"	*	"	"	"
146	10 "	"	9990	"	**	"	"	"
147	5 "	"	9995	"	*** S	Normal, soft	Pale green.	Moderately
148	10 "	"	9990	"	**	Dark green ...	hairy	...
149	5 "	"	9995	"	***	Normal but dark	Purple green	...
150	1 "	"	9999	"	***	Normal	"	...
151	50 parts	Urea.	9950 parts	Sterilised Soil	—	—	—	—
152	30 "	"	9970	"	—	—	—	—
153	10 "	"	9990	"	*	Deep green, Blotchy	Purple green. short	Hairs ...
154	5 "	"	9995	"	**	Deep green ...	"	"
155	10 "	"	9990	"	**	"	"	"
156	5 "	"	9995	"	**	"	"	"
157	1 "	"	9999	"	*** S	Pale, soft	"	"
						Pale, thick	...	...

Harmful above 0.05%.

Harmful above 0.01%.
Lowest concentration
gave soft seedlings.

Conclusions.

The results from these experiments indicate that baked cucumber soil is an excellent medium for tomato seedlings and can be improved only by incorporating clay with it in the proportion of three parts soil and one part clay. Clay should be dug out during the summer and laid out to dry, when it can be powdered and mixed with the baked soil prior to filling the boxes. If it is taken some three feet below the surface there is little risk of it being contaminated with disease organisms.

No benefit was derived by adding fertilisers to the baked soil. Fish manure and superphosphate were the least harmful of the fertilisers employed, and in low concentrations tended to produce a soft growth.

The results clearly indicate that serious damage can be caused to seedlings in boxes by an excess of fertilisers in the compost, and show that the physical condition of the soil is the most important condition governing the preparation of composts. The soil must be sufficiently heavy to prevent frequent watering and sufficiently open for correct aeration. The investigation will be extended in the future to experiments with composts for pot work.

Dates of Cultural Operations during 1925—1926.

Crop.	Sown.	Potted into 60's.	Potted into 32's.	Planted out in borders.	First Mulching.	First Top Dressing.	First Fruit Picking.	Last Fruit Picking.
Tomatoes	Dec. 30 1925	Feb. 4 1926	—	Mar. 4 1926	—	May 12 1926	June 26 1926	Oct. 14 1926
Cucumbers	Dec. 30 1925	Jan. 6 1926	Feb. 2 1926	Feb. 23 1926	Mar. 10 1926	April 15 1926	Mar. 24 1926	Oct. 4 1926

Meteorological Records, 1926.

Month.	Rain.		Average outside Temperatures.		Bright Sunshine.
	Total fall. 5 inch Funnel Gauge.	No. of Rainy Days.	Day Maxm. °F.	Night Minm. °F.	Daily average in hours.
	Inches.				
January	3.01	20	44.4	34.2	1.21
February	2.71	16	49.5	40.1	1.29
March	0.27	6	50.8	40.3	3.50
April	3.03	17	57.4	40.6	3.50
May	1.69	17	59.2	44.2	5.18
June	3.31	13	65.6	49.5	6.43
July	2.40	13	70.9	55.5	5.47
August	1.44	17	71.6	54.5	6.78
September	1.56	10	68.0	52.5	4.45
October... ..	2.38	15	54.2	41.0	3.04
November	4.72	24	49.0	39.2	1.28
December	0.34	7	43.4	34.9	1.69
Total or Mean... ..	26.86	175	57.0	43.7	3.65

APPENDIX.

Table I.

G1. 15 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.04	1.66	.48	.23	.17	3.58	27.21	68.86
B.	—	.06	.39	.17	.15	.19	.96	7.29	18.45
C.	—	—	.02	.02	—	.08	.12	.91	2.26
D.	—	—	.06	.03	.04	.02	.15	1.14	2.88
E.	—	—	.11	—	—	—	.11	.84	2.17
F.	—	—	—	—	—	—	—	—	—
G.	—	.03	.15	.07	.03	—	.28	2.13	5.38
Total	—	1.13	2.39	.77	.45	.46	5.20	39.52	100

Table II.

G6. 15 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.81	1.47	.34	.26	.08	2.96	22.49	68.27
B.	—	.10	.40	.18	.15	.09	.92	6.99	21.20
C.	—	—	—	—	—	.07	.07	.53	1.61
D.	—	—	.05	.03	.02	.01	.11	.84	2.55
E.	—	.01	.04	.01	—	—	.06	.46	1.31
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.18	.01	.01	—	.22	1.67	5.06
Total	—	.94	2.14	.57	.44	.25	4.34	32.98	100

Table III.

G2. 30 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.78	1.49	.55	.31	.10	3.23	24.55	73.53
B.	—	.04	.39	.17	.14	.11	.85	6.46	19.20
C.	—	—	.01	—	—	.06	.07	.53	1.80
D.	—	—	.06	.05	.02	—	.13	.99	2.85
E.	—	—	.04	—	—	—	.04	.30	.81
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.07	.01	—	—	.08	.61	1.81
Total	—	.82	2.14	.84	.48	.27	4.40	33.44	100

Table IV.

G5. 30 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.67	1.32	.39	.24	.10	2.72	20.67	64.48
B.	—	.09	.46	.19	.15	.08	.97	7.37	22.99
C.	—	—	.01	—	—	.07	.08	.61	1.90
D.	—	—	.08	.04	.04	.01	.15	1.14	3.54
E.	—	—	.01	—	—	—	.01	.08	.24
F.	—	—	—	—	—	—	—	—	—
G.	—	.05	.16	.04	.04	—	.29	2.20	6.85
Total	—	.81	2.02	.66	.47	.26	4.22	32.07	100

Table V.

G4. 60 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.43	1.56	.45	.20	.10	2.74	20.82	65.54
B.	—	.08	.48	.23	.14	.08	1.01	7.68	24.17
C.	—	—	—	—	—	.07	.07	.51	1.60
D.	—	—	.03	.06	.03	.01	.13	1.00	3.14
E.	—	—	.01	—	—	—	.01	.08	.30
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.10	.03	.06	.01	.22	1.67	5.25
Total	—	.53	2.18	.77	.43	.27	4.18	31.76	100

Table VI.

G7. 60 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.86	1.41	.28	.31	.08	2.94	22.34	68.53
B.	—	.14	.49	.20	.11	.10	1.04	7.90	24.23
C.	—	—	.01	—	—	—	.01	.08	.25
D.	—	.02	.02	.05	.02	—	.09	.68	2.09
E.	—	—	.04	—	—	—	.04	.31	.95
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.10	.04	.01	—	.17	1.29	3.95
Total	—	1.02	2.07	.57	.45	.18	4.29	32.60	100

Table VII.

G3. 90 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.61	1.61	.34	.22	.09	2.87	21.82	69.90
B.	—	.06	.44	.21	.14	.12	.97	7.37	23.60
C.	—	—	.01	—	—	.08	.09	.68	2.17
D.	—	—	.03	.03	.02	.01	.09	.68	2.17
E.	—	—	.01	—	—	—	.01	.07	.21
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.05	.02	.01	—	.08	.61	1.95
Total	—	.67	2.15	.60	.39	.30	4.11	31.23	100

Table VIII.

G8. 90 Tons Stable Manure per Acre. Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.17	1.38	.38	.32	.14	3.29	25.76	74.49
B.	—	.06	.40	.19	.09	.06	.80	6.08	17.58
C.	—	—	.02	—	—	—	.02	.15	.44
D.	—	—	.06	.03	.02	.02	.13	.99	2.86
E.	—	—	.03	—	—	—	.03	.23	.67
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.10	.03	.02	.02	.18	1.37	3.96
Total	—	1.24	1.99	.63	.45	.24	4.55	34.58	100

Table IX.

H2. Normal Watering.

Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.29	1.07	.27	.19	.12	2.94	22.34	69.84
B.	—	.14	.25	.20	.14	.02	.75	5.70	17.82
C.	—	—	.01	—	—	—	.01	.08	.25
D.	—	—	—	.04	.04	.01	.09	.68	2.12
E.	—	—	.09	—	—	—	.09	.68	2.12
F.	—	—	—	—	—	—	—	—	—
G.	—	.04	.15	.11	.02	.01	.33	2.51	7.85
Total	—	1.47	1.57	.62	.39	.16	4.21	31.99	100

Table X.

H5. Normal Watering.

Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.26	1.23	.19	.13	.11	2.92	22.19	65.46
B.	—	.21	.41	.25	.17	.10	1.14	8.66	25.55
C.	—	.01	—	—	—	—	.01	.08	.24
D.	—	—	.01	.04	.02	.02	.09	.68	2.01
E.	—	.01	.03	—	—	—	.04	.30	.89
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.12	.08	.02	.02	.26	1.98	5.85
Total	—	1.51	1.80	.56	.34	.25	4.46	33.89	100

Table XI.

H1. Watering begun 10 days earlier than usual. Normal Supply.
Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.47	1.16	.18	.10	.09	3.00	22.80	66.09
B.	—	.21	.35	.13	.15	.02	.85	6.46	18.73
C.	—	—	.02	—	—	—	.02	.15	.43
D.	—	—	.03	.04	.04	.01	.12	.91	2.64
E.	—	.02	.11	.01	—	—	.14	1.06	3.07
F.	—	—	—	—	—	—	—	—	—
G.	—	.06	.16	.12	.06	—	.41	3.12	9.04
Total	—	1.76	1.83	.48	.35	.12	4.54	34.50	100

Table XII.

H6. Watering begun 10 days earlier than usual. Normal Supply.
Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.22	1.33	.32	.07	.05	2.99	22.71	68.53
B.	—	.26	.34	.30	.09	.05	1.04	7.90	23.84
C.	—	.01	.01	—	—	—	.02	.14	.42
D.	—	—	—	.03	.01	.02	.06	.44	1.33
E.	—	—	.01	—	—	—	.01	.07	.21
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.07	.11	.03	.01	.24	1.88	5.67
Total	—	1.51	1.76	.76	.20	.13	4.36	33.14	100

Table XIII.

H4. 50% more Water than Normal.

Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.25	.31	.29	.07	.11	2.03	15.43	45.72
B.	—	.20	1.54	.26	.15	.04	2.19	16.64	49.32
C.	—	—	.01	—	—	—	.01	.08	.24
D.	—	—	.01	.03	.01	.03	.08	.61	1.80
E.	—	.01	.01	—	—	—	.02	.15	.44
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.04	.05	.02	—	.11	.84	2.48
Total	—	1.46	1.92	.63	.25	.18	4.44	33.75	100

Table XIV.

H7. 50% more Water than Normal.

Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.17	.94	.25	.10	.10	2.56	19.46	66.18
B.	—	.17	.30	.21	.12	.04	.84	6.38	21.80
C.	—	—	—	—	—	—	—	—	—
D.	—	—	—	.04	.01	.02	.07	.53	1.80
E.	—	.01	.07	—	—	—	.08	.61	2.07
F.	—	—	—	—	—	—	—	—	—
G.	—	.11	.14	.06	.01	—	.32	2.43	8.15
Total	—	1.46	1.45	.56	.24	.16	3.87	29.41	100

Table XV.

H3. 100% more Water than usual.

Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.40	1.28	.26	.06	.13	3.13	23.79	69.72
B.	—	.22	.39	.24	.11	.08	1.04	7.91	23.18
C.	—	—	—	.01	—	—	.01	.07	.21
D.	—	—	.02	.03	.02	.03	.10	.76	2.23
E.	—	.01	—	—	—	—	.01	.07	.21
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.08	.06	.03	.02	.20	1.52	4.45
Total	—	1.64	1.77	.60	.12	.26	4.49	34.12	100

Table XVI.

H8. 100% more Water than usual.

Variety—"E.S. 1."

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.08	.94	.30	.15	.12	2.59	19.68	62.12
B.	—	.17	.29	.21	.14	.04	.85	6.46	20.38
C.	—	.01	—	—	—	—	.01	.07	.22
D.	—	—	.01	.03	.02	.03	.09	.68	2.15
E.	—	.01	.07	—	—	—	.08	.62	1.95
F.	—	—	—	—	—	—	—	—	—
G.	—	.19	.21	.11	.04	—	.55	4.18	13.18
Total	—	1.46	1.52	.65	.35	.19	4.17	31.69	100

Table XVII.

Variety—"Manx Marvel" (in each plot of Series J).

J1a. Stable Manure, Sulphate of Ammonia, and Sulphate of Potash.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.04	.50	.27	.34	.24	2.39	18.17	62.59
B.	—	.26	.52	.15	.20	.08	1.21	9.19	31.66
C.	—	.04	—	—	—	—	.04	.30	1.03
D.	—	—	—	.01	.01	.01	.03	.23	.79
E.	—	.05	.03	—	—	—	.08	.61	2.10
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.05	—	—	—	.07	.53	1.83
Total	—	1.41	1.10	.43	.55	.33	3.82	29.03	100

Table XVIII.

J1b. Stable Manure, Sulphate of Ammonia, Sulphate of Potash plus Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.88	.68	.34	.38	.20	2.48	18.85	62.81
B.	—	.23	.59	.17	.20	.08	1.27	9.65	32.15
C.	—	.02	.02	.01	.03	—	.08	.61	2.03
D.	—	—	—	.01	.01	.01	.03	.23	.76
E.	—	.04	.02	.01	—	—	.07	.53	1.76
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	—	—	.01	—	.02	.15	.49
Total	—	1.18	1.31	.54	.63	.29	3.95	30.02	100

Table XIX.

J2a. Unmanured.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.41	.27	.10	.15	.07	1.00	7.60	35.60
B.	—	.06	.19	.07	.07	.04	.43	3.27	15.32
C.	—	.01	.10	—	.01	—	.12	.91	4.26
D.	—	—	—	.01	.01	.01	.03	.23	1.08
E.	—	.72	.41	.05	.03	—	1.21	9.19	43.04
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.01	.01	—	.02	.15	.70
Total	—	1.20	.97	.24	.28	.12	2.81	21.35	100

Table XX.

J2b. 14lbs. Stable Manure per sq. yard 1925.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.90	.77	.12	.08	.17	2.04	15.50	54.81
B.	—	.14	.44	.11	.08	.04	.81	6.16	21.80
C.	—	.03	.03	—	—	—	.06	.46	1.63
D.	—	—	—	—	.02	—	.02	.15	.53
E.	—	.46	.31	.01	—	—	.78	5.93	20.98
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.01	—	—	.01	.07	.25
Total	—	1.53	1.55	.25	.18	.21	3.72	28.27	100

Table XXI.

J2c. 28 lbs. Stable Manure per sq. yard 1926.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.73	.93	.15	.08	.15	2.04	15.51	60.22
B.	—	.10	.45	.10	.10	.04	.79	6.00	23.30
C.	—	.05	—	—	—	—	.05	.38	1.47
D.	—	—	—	.01	.01	—	.02	.15	.57
E.	—	.20	.20	.08	.01	—	.49	3.72	14.44
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—	—
Total	—	1.08	1.58	.34	.20	.19	3.39	25.76	100

Table XXII.

J3a. 5% Potash only.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.20	1.08	.41	.38	.41	3.48	26.45	67.58
B.	—	.16	.56	.18	.11	.05	1.06	8.06	20.59
C.	—	.05	.16	—	.01	—	.22	1.67	4.27
D.	—	—	—	.02	.01	—	.03	.23	.59
E.	—	.14	.07	.07	.03	—	.31	2.35	6.00
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.01	.02	.01	—	.05	.38	.97
Total	—	1.56	1.88	.70	.55	.46	5.15	39.14	100

Table XXIII.

J3b. 2½% Nitrogen plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.10	.88	.38	.28	.25	2.89	21.96	63.65
B.	—	.15	.61	.30	.16	.03	1.25	9.50	27.54
C.	—	.05	.02	—	.01	—	.08	.61	1.77
D.	—	—	—	.03	.02	—	.05	.38	1.10
E.	—	.06	.16	.01	—	—	.23	1.75	5.07
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	—	—	.03	—	.04	.30	.87
Total	—	1.37	1.67	.72	.50	.28	4.54	34.50	100

Table XXIV.

J3c. 5% Nitrogen plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.02	.85	.20	.34	.27	2.68	20.37	63.53
B.	—	.25	.55	.17	.22	.07	1.26	9.58	29.88
C.	—	—	—	—	.01	—	.01	.08	.24
D.	—	—	—	.01	.01	—	.02	.15	.46
E.	—	.06	.09	.06	—	—	.21	1.59	4.96
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.02	.01	—	.04	.30	.93
Total	—	1.33	1.50	.46	.59	.34	4.22	32.07	100

Table XXV.

J3d. 7 $\frac{1}{2}$ % Nitrogen plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.06	.75	.36	.32	.27	2.76	20.98	64.04
B.	—	.19	.72	.17	.18	.07	1.33	10.11	30.88
C.	—	.04	.01	—	—	—	.05	.38	1.17
D.	—	—	—	—	.01	—	.01	.07	.21
E.	—	.05	.09	—	—	—	.14	1.06	3.24
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	—	—	—	.02	.15	.46
Total	—	1.34	1.59	.53	.51	.34	4.31	32.75	100

Table XXVI.

J4a. 5% Phosphates plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.08	.98	.52	.14	.38	3.10	23.56	66.39
B.	—	.18	.50	.16	.10	.07	1.01	7.68	21.64
C.	—	.03	.12	—	.01	—	.16	1.21	3.41
D.	—	—	—	.02	.01	—	.03	.23	.65
E.	—	.13	.08	.05	.02	—	.28	2.13	6.00
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.05	.03	—	.09	.68	1.91
Total	—	1.42	1.69	.80	.31	.45	4.67	35.49	100

Table XXVII.

J4b. 2½% Nitrogen plus 5% Phosphates plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.16	.73	.47	.13	.31	2.80	21.28	63.09
B.	—	.19	.63	.38	.08	.07	1.35	10.26	30.42
C.	—	.03	—	—	.01	—	.04	.30	.89
D.	—	.03	.01	—	.02	—	.06	.45	1.33
E.	—	.05	.04	.06	—	—	.15	1.14	3.38
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.03	—	—	—	.04	.30	.89
Total	—	1.47	1.44	.91	.24	.38	4.44	33.73	100

Table XXVIII.

J4c. 5% Nitrogen plus 5% Phosphates plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.87	.56	.42	.13	.28	2.26	17.18	60.29
B.	—	.19	.57	.10	.09	.11	1.06	8.06	28.28
C.	—	—	.04	—	—	—	.04	.30	1.05
D.	—	—	—	.03	.01	—	.04	.30	1.05
E.	—	.14	.12	.01	—	—	.27	2.05	7.19
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.06	.01	—	—	.08	.61	2.14
Total	—	1.21	1.35	.57	.23	.39	3.75	28.50	100

Table XXIX.

J4d. 7½% Nitrogen plus 5% Phosphate plus 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.15	.67	.45	.18	.33	2.78	21.13	64.96
B.	—	.25	.57	.11	.11	.12	1.16	8.82	27.11
C.	—	.10	.05	—	—	—	.15	1.14	3.50
D.	—	—	—	.01	—	.01	.02	.15	.46
E.	—	.01	.15	—	—	—	.16	1.21	3.72
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	—	—	—	.01	.08	.25
Total	—	1.51	1.45	.57	.29	.46	4.28	32.53	100

Table XXX.

J5a. Complete Artificials.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.01	.75	.23	.27	.23	2.49	17.92	63.60
B.	—	.17	.46	.12	.13	.12	1.00	7.60	26.98
C.	—	.01	—	—	—	—	.01	.07	.24
D.	—	—	—	.04	.01	—	.05	.38	1.34
E.	—	.15	.06	.01	.01	—	.23	1.75	6.21
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.01	.04	—	.06	.46	1.63
Total	—	1.34	1.28	.41	.46	.35	3.84	28.18	100

Table XXXI.

J5b. Complete Artificial plus Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	--	.98	.69	.21	.28	.15	2.31	17.56	61.62
B.	--	.21	.41	.15	.13	.17	1.07	8.13	28.53
C.	--	.04	.01	.01	--	--	.06	.46	1.61
D.	--	--	--	.03	.02	--	.05	.38	1.33
E.	--	.09	.10	.02	.01	--	.22	1.67	5.86
F.	--	--	--	--	--	--	--	--	--
G.	--	--	.01	.01	.02	--	.04	.30	1.05
Total	--	1.32	1.22	.43	.46	.32	3.75	28.50	100

Table XXXII.

J6a. Complete Artificial without Nitrogen.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	--	1.33	.91	.18	.18	.27	2.87	21.81	66.61
B.	--	.14	.44	.14	.11	.13	.96	7.30	22.29
C.	--	--	.01	--	--	--	.01	.07	.21
D.	--	--	--	.03	.03	--	.06	.46	1.40
E.	--	.13	.08	.04	--	--	.25	1.90	5.80
F.	--	--	--	--	--	--	--	--	--
G.	--	.02	.06	.04	.04	--	.16	1.21	3.69
Total	--	1.62	1.50	.43	.36	.40	4.31	32.75	100

Table XXXIII.

J6b. 8% Phosphate.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.42	.94	.21	.18	.20	2.95	22.42	69.73
B.	—	.08	.52	.10	.15	.11	.96	7.30	22.72
C.	—	.04	.01	—	—	—	.05	.38	1.18
D.	—	—	—	.02	—	.01	.03	.23	.71
E.	—	.08	.04	.02	—	—	.14	1.06	3.30
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.03	.03	.04	—	.10	.76	2.36
Total	—	1.62	1.54	.38	.37	.32	4.23	32.15	100

Table XXXIV.

J6c. 16% Phosphate.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.21	1.08	.14	.13	.19	2.75	20.90	67.24
B.	—	.16	.48	.08	.08	.14	.94	7.14	22.97
C.	—	.01	.05	—	—	—	.06	.46	1.48
D.	—	—	—	.01	.01	.04	.06	.46	1.48
E.	—	.11	.04	.02	.01	—	.18	1.36	4.38
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.08	.01	—	.10	.76	2.45
Total	—	1.49	1.66	.33	.24	.37	4.09	31.08	100

Table XXXV.

J6d. 24% Phosphate.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.17	.99	.16	.18	.21	2.71	20.60	63.20
B.	—	.30	.63	.12	.12	.09	1.26	9.58	29.39
C.	—	.01	.06	—	—	—	.07	.53	1.63
D.	—	—	—	.02	.01	—	.03	.23	.70
E.	—	.09	.01	—	—	—	.10	.76	2.33
F.	—	.01	—	—	—	—	.01	.07	.21
G.	—	—	.02	.06	.03	—	.11	.83	2.54
Total	—	1.58	1.71	.36	.34	.30	4.29	32.60	100

Table XXXVI.

J7a. C.A. without Nitrogen.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.14	.44	.17	.11	.19	2.05	15.58	68.78
B.	—	.16	.10	.17	.10	.05	.58	4.41	19.47
C.	—	—	—	—	—	—	—	—	—
D.	—	—	—	.01	.02	—	.03	.23	1.02
E.	—	.10	.13	.03	.03	—	.29	2.20	9.71
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.01	.02	—	.03	.23	1.02
Total	—	1.40	.67	.39	.28	.24	2.98	22.65	100

Table XXXVII.

J7b. 5% Nitrogen.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.42	.86	.27	.28	.18	3.01	22.88	69.52
B.	—	.15	.35	.17	.18	.05	.90	6.84	20.79
C.	—	—	—	—	—	—	—	—	—
D.	—	—	—	.01	.02	—	.03	.23	.70
E.	—	.06	.18	.07	.02	—	.33	2.51	7.63
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.02	.04	—	.06	.45	1.37
Total	—	1.63	1.39	.54	.54	.23	4.33	32.91	100

Table XXXVIII.

J7c. 7½% Nitrogen.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.46	.99	.22	.43	.19	3.24	24.63	73.15
B.	—	.14	.36	.15	.18	.04	.87	6.61	19.64
C.	—	.03	—	—	—	—	.03	.23	.68
D.	—	—	—	.03	.01	—	.04	.30	.89
E.	—	.04	.12	.02	.02	—	.20	1.52	4.51
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.02	.02	—	.05	.38	1.13
Total	—	1.67	1.43	.44	.66	.23	4.43	33.67	100

Table XXXIX.

J7d. 10% Nitrogen.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.32	.93	.19	.35	.11	2.90	22.04	68.90
B.	—	.21	.44	.08	.21	.04	.98	7.45	23.29
C.	—	—	.01	—	.01	—	.02	.15	.47
D.	—	—	—	—	.01	—	.01	.07	.22
E.	—	.07	.03	.04	—	—	.14	1.06	3.31
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.06	.09	—	.16	1.22	3.81
Total	—	1.60	1.42	.37	.67	.15	4.21	31.99	100

Table XL.

J8a. C.A. without Potash.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.84	.61	.13	.27	.18	2.03	15.43	56.24
B.	—	.04	.35	.05	.09	.05	.58	4.41	16.08
C.	—	—	—	.01	—	—	.01	.07	.26
D.	—	—	—	—	.04	.03	.07	.53	1.94
E.	—	.63	.13	.11	—	—	.87	6.61	24.09
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.04	.01	—	.05	.38	1.39
Total	—	1.51	1.09	.34	.41	.26	3.61	27.43	100

Table XLI.

J8b. 7½% Potash.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.10	.96	.20	.35	.18	2.79	21.20	63.71
B.	—	.07	.48	.11	.14	.07	.87	6.61	19.86
C.	—	.01	.01	—	—	—	.02	.15	.45
D.	—	—	—	.01	.02	—	.03	.23	.69
E.	—	.32	.11	.13	.02	—	.58	4.41	13.25
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.04	.04	—	.09	.68	2.04
Total	—	1.50	1.57	.49	.57	.25	4.38	33.28	100

Table XLII.

J8c. 10% Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.14	.92	.19	.23	.19	2.67	20.29	61.67
B.	—	.20	.53	.15	.14	.07	1.09	8.28	25.17
C.	—	—	.03	—	—	—	.03	.23	.70
D.	—	—	—	.01	.02	.02	.05	.38	1.16
E.	—	.24	.08	.03	—	—	.35	2.66	8.08
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.08	.06	—	.14	1.06	3.22
Total	—	1.58	1.56	.46	.45	.28	4.33	32.90	100

Table XLIII.

J8d. 12 $\frac{1}{2}$ % Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.16	1.07	.19	.34	.17	2.93	22.27	63.02
B.	—	.12	.55	.12	.11	.09	.99	7.53	21.30
C.	—	.02	.04	—	.01	—	.07	.53	1.50
D.	—	—	—	.02	.01	—	.03	.23	.65
E.	—	.27	.10	.02	—	—	.39	2.96	8.38
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.08	.15	—	.24	1.82	5.15
Total	—	1.57	1.77	.43	.62	.26	4.65	35.34	100

Table XLIV.

Variety—"Manx Marvel" (in each plot of Series K).

K1a. Twice Complete Artificials (Formula I.) and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.93	.66	.35	.15	.15	2.24	17.03	59.14
B.	—	.33	.48	.18	.10	.16	1.25	8.50	29.53
C.	—	.01	.01	—	—	—	.02	.15	.53
D.	—	—	—	.03	.02	—	.05	.38	1.32
E.	—	.03	.05	.01	—	—	.09	.68	2.36
F.	—	—	—	.11	.03	—	.14	1.06	3.68
G.	—	.01	.01	.05	.06	—	.13	.99	3.44
Total	—	1.31	1.21	.73	.36	.31	3.92	28.79	100

Table XLV.

K1b. Twice Complete Artificial (Formula I.).

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.69	.69	.25	.19	.17	1.99	15.12	58.70
B.	—	.22	.45	.21	.14	.18	1.20	9.12	35.41
C.	—	.01	—	—	—	—	.01	.08	.31
D.	—	—	.01	.02	.01	—	.04	.30	1.17
E.	—	.01	.04	.02	—	—	.07	.53	2.05
F.	—	—	—	.01	.01	—	.02	.15	.58
G.	—	.02	.01	.02	.01	—	.06	.46	1.78
Total	—	.95	1.20	.53	.36	.35	3.39	25.76	100

Table XLVI.

K2a. Grass only.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.35	.35	.12	.11	.05	.98	7.45	34.29
B.	—	.06	.27	.05	.09	.01	.48	3.65	16.80
C.	—	.01	.03	.01	.01	—	.06	.45	2.07
D.	—	—	.04	—	.01	—	.05	.38	1.75
E.	—	.57	.61	.06	.01	—	1.25	9.50	43.71
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.02	.01	—	.04	.30	1.38
Total	—	.99	1.31	.26	.24	.06	2.86	21.73	100

Table XLVII.

K2b. Unmanured.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.39	.31	.16	.06	.09	1.01	7.67	39.44
B.	—	.09	.19	.11	.05	.01	.45	3.42	17.58
C.	—	.01	.01	—	—	—	.02	.15	.77
D.	—	—	—	—	.01	—	.01	.08	.41
E.	—	.40	.53	.06	.02	—	1.01	7.67	39.44
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.05	.01	—	.06	.46	2.36
Total	—	.89	1.04	.38	.15	.10	2.56	19.45	100

Table XLVIII.

K3a. Complete Artificial (Formula I.) with Standard and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.94	.70	.29	.24	.10	2.27	17.25	56.46
B.	—	.36	.43	.21	.15	.18	1.33	10.11	33.10
C.	—	.05	.02	.01	—	—	.08	.61	2.00
D.	—	—	—	.02	.02	—	.04	.30	.98
E.	—	.13	.09	.02	—	—	.24	1.82	5.96
F.	—	.01	—	—	—	—	.01	.08	.26
G.	—	.01	.02	.01	.01	—	.05	.38	1.24
Total	—	1.50	1.26	.56	.42	.28	4.02	30.55	100

Table XLIX.

K3b. Complete Artificial (Formula I.) with Standard.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.82	.66	.23	.29	.16	2.16	16.42	53.09
B.	—	.52	.50	.19	.12	.16	1.49	11.32	36.60
C.	—	.04	.03	—	—	—	.07	.53	1.71
D.	—	—	.03	.02	.02	—	.07	.53	1.71
E.	—	.03	.11	.03	—	—	.17	1.29	4.17
F.	—	.01	—	.04	.01	—	.06	.46	1.49
G.	—	—	.02	.01	.02	—	.05	.38	1.23
Total	—	1.42	1.35	.52	.46	.32	4.07	30.93	100

Table L.

K4a. Complete Artificial (Formula I.) with Stable Manure and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.97	.77	.27	.16	.10	2.27	17.25	55.64
B.	—	.33	.51	.17	.14	.16	1.31	9.96	32.13
C.	—	.01	.02	—	—	—	.03	.23	.74
D.	—	—	.01	.01	.02	—	.04	.30	.97
E.	—	.02	.15	.02	—	—	.19	1.44	4.65
F.	—	—	—	—	—	—	—	—	—
G.	—	.03	.18	.01	.02	—	.24	1.82	5.87
Total	—	1.36	1.64	.48	.34	.26	4.08	31.00	100

Table LI.

K4b. Complete Artificial (Formula I.) with Stable Manure.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.03	.82	.27	.17	.19	2.48	18.85	63.78
B.	—	.25	.68	.15	.07	.01	1.16	8.82	29.84
C.	—	.02	—	—	—	—	.02	.15	.50
D.	—	—	—	—	.02	—	.02	.15	.50
E.	—	.07	.07	.01	.01	—	.16	1.21	4.09
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	—	.01	.02	—	.05	.38	1.29
Total	—	1.39	1.57	.44	.29	.20	3.89	29.56	100

Table LII.

K5a. Complete Artificial (Formula I.) and Grass.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.30	.66	.28	.37	.20	2.81	21.36	66.92
B.	—	.24	.41	.13	.20	.01	.99	7.52	23.56
C.	—	.02	.04	—	—	—	.06	.46	1.44
D.	—	—	—	.02	.03	—	.05	.38	1.19
E.	—	.08	.11	.01	.02	—	.22	1.67	5.23
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	.03	.02	—	.07	.53	1.66
Total	—	1.64	1.24	.47	.64	.21	4.20	31.92	100

Table LIII.

K5b. Complete Artificial (Formula I.).

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.18	.64	.28	.24	.20	2.54	19.31	64.66
B.	—	.22	.34	.16	.21	—	.93	7.07	23.67
C.	—	.01	.01	—	—	—	.02	.15	.50
D.	—	—	.02	.02	.05	—	.09	.68	2.27
E.	—	.09	.12	.03	.01	—	.25	1.90	6.36
F.	—	—	—	—	.01	—	.01	.08	.27
G.	—	—	.04	.04	.01	—	.09	.68	2.27
Total	—	1.50	1.17	.53	.53	.20	3.93	29.87	100

Table LIV.

K6a. Complete Artificial (Formula I.) without Phosphates and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.16	.84	.36	.36	.11	2.83	21.51	69.89
B.	—	.24	.39	.14	.15	.01	.93	7.07	22.97
C.	—	.02	.01	.01	—	—	.04	.30	.97
D.	—	—	—	.01	.03	—	.04	.30	.97
E.	—	.04	.05	.02	.03	—	.14	1.07	3.48
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.01	.03	.01	—	.07	.53	1.72
Total	—	1.48	1.30	.57	.58	.12	4.05	30.78	100

Table LV.

K6b. Complete Artificial (Formula I.) without Phosphates.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.24	.88	.34	.31	.16	2.93	22.27	67.84
B.	—	.20	.48	.15	.14	.01	.98	7.45	22.70
C.	—	.03	—	.01	—	—	.04	.30	.91
D.	—	—	.01	.01	.03	—	.05	.38	1.15
E.	—	.04	.11	.03	.02	—	.20	1.52	4.63
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.09	.01	.01	—	.12	.91	2.77
Total	—	1.52	1.57	.55	.51	.17	4.32	32.83	100

Table LVI.

K7a. Complete Artificial (Formula I.) without Nitrogen and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.10	.39	.19	.20	.11	1.99	15.12	60.85
B.	—	.29	.19	.16	.14	.02	.80	6.08	24.47
C.	—	.02	.01	—	—	—	.03	.23	.93
D.	—	—	.01	—	.04	—	.05	.38	1.53
E.	—	.12	.15	.10	.01	—	.38	2.89	11.62
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.01	.01	—	.02	.15	.60
Total	—	1.53	.75	.46	.40	.13	3.27	24.85	100

Table LVII.

K7b. Complete Artificial (Formula I.) without Nitrogen.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.15	.33	.11	.17	.06	1.82	13.83	58.71
B.	—	.29	.19	.13	.12	.01	.74	5.62	23.85
C.	—	.05	.02	—	—	—	.07	.53	2.25
D.	—	—	.01	.01	.03	—	.05	.38	1.61
E.	—	.11	.16	.09	.04	—	.40	3.04	12.90
F.	—	.01	—	—	—	—	.01	.08	.34
G.	—	—	—	.01	—	—	.01	.08	.34
Total	—	1.61	.71	.35	.36	.07	3.10	23.56	100

Table LVIII.

K8. Complete Artificial (Formula I.) without Potash and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.74	.36	.13	.13	.10	1.46	11.09	43.30
B.	—	.13	.25	.06	.14	—	.58	4.41	17.22
C.	—	.01	.03	.02	—	—	.06	.46	1.80
D.	—	—	—	—	.04	—	.04	.30	1.17
E.	—	.59	.43	.10	.05	—	1.17	8.89	34.71
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.03	.01	.02	—	.06	.46	1.80
Total	—	1.47	1.10	.32	.38	.10	3.37	25.61	100

Table LIX.

K8b. Complete Artificial (Formula I.) without Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.60	.37	.09	.17	.10	1.33	10.11	44.34
B.	—	.09	.25	.06	.13	—	.53	4.03	17.68
C.	—	—	.02	.01	—	—	.03	.23	1.01
D.	—	—	—	.01	.06	—	.07	.53	2.32
E.	—	.53	.39	.04	.03	—	.99	7.52	32.98
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.03	.02	—	—	.05	.38	1.67
Total	—	1.22	1.06	.23	.39	.10	3.00	22.80	100

Table LX.

Variety—"E.S. 1" (throughout Series N., O., P., Q.).

N1. Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.55	1.69	.52	.43	.19	4.38	33.29	70.42
B.	—	.13	.68	.17	.11	.19	1.18	8.97	18.98
C.	—	—	.02	—	—	.15	.17	1.29	2.73
D.	—	—	.08	.08	.02	.15	.33	2.51	5.31
E.	—	.02	.01	—	—	—	.03	.23	.49
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.06	.06	.01	—	.13	.99	2.07
Total	—	1.70	2.44	.83	.57	.68	6.22	47.28	100

Table LXI.

N2. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.72	1.41	.68	.57	.22	4.60	34.96	75.43
B.	—	.15	.50	.16	.11	.16	1.08	8.21	17.71
C.	—	—	.01	—	—	.13	.14	1.06	2.29
D.	—	—	.06	.08	.02	.01	.17	1.29	2.78
E.	—	—	.01	—	—	—	.01	.07	.15
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.03	.05	.02	—	.10	.76	1.64
Total	—	1.87	2.02	.97	.72	.52	6.10	46.35	100

Table LXII.

Magnesium Sulphate.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.84	1.22	.59	.55	.20	4.40	33.44	78.29
B.	—	.11	.40	.13	.13	.16	.93	7.07	16.55
C.	—	—	.02	—	—	—	.02	.15	.35
D.	—	—	.06	.06	.02	—	.14	1.06	2.48
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.03	.08	.02	—	.13	.99	2.33
Total	—	1.95	1.73	.86	.72	.36	5.62	42.71	100

Table LXIII.

N6. Fallow 1923 and 1924, Cropped 1925 and 1926.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.39	1.87	.82	.65	.36	5.09	38.68	77.94
B.	—	.08	.52	.25	.13	.07	1.05	7.98	16.08
C.	—	—	.04	—	—	—	.04	.30	.60
D.	—	—	.08	.07	.02	.01	.18	1.37	2.76
E.	—	—	.06	—	—	—	.06	.46	.93
F.	—	—	.01	—	—	—	.01	.07	.15
G.	—	—	.04	.06	—	—	.10	.76	1.54
Total	—	1.47	2.62	1.20	.80	.44	6.53	49.62	100

Table LXIV.

N7. Fallow 1923 and 1925, Cropped 1924 and 1926.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.48	1.48	.76	.57	.42	4.71	35.80	76.96
B.	—	.21	.47	.26	.15	.04	1.13	8.59	18.47
C.	—	—	.02	—	—	—	.02	.15	.33
D.	—	—	.03	.10	.03	.01	.17	1.29	2.77
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.08	.01	—	.09	.68	1.47
Total	—	1.69	2.00	1.20	.76	.47	6.12	46.51	100

Table LXV.

N8. Control.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.66	1.51	.70	.31	.15	4.33	32.91	75.97
B.	—	.15	.46	.20	.13	.13	1.07	8.13	18.77
C.	—	—	.04	—	—	—	.04	.30	.69
D.	—	—	.02	.05	.02	.01	.10	.76	1.75
E.	—	—	.03	—	—	—	.03	.23	.53
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.06	.07	—	—	.13	.99	2.29
Total	—	1.81	2.12	1.02	.46	.29	5.70	43.32	100

Table LXVI.

N9. Magnesium Carbonate.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.86	1.31	.54	.24	.24	4.19	31.84	73.52
B.	—	.17	.47	.18	.13	.19	1.14	8.66	19.99
C.	—	.01	.02	—	—	—	.03	.23	.53
D.	—	—	.06	.08	.03	.01	.18	1.37	3.16
E.	—	—	.02	—	—	—	.02	.15	.35
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.04	.08	—	—	.14	1.06	2.45
Total	—	2.06	1.92	.88	.40	.44	5.70	43.31	100

Table LXVII.

N10. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.49	1.34	.66	.33	.22	4.04	30.70	72.40
B.	—	.11	.47	.20	.11	.19	1.08	8.21	19.36
C.	—	—	.01	—	—	.06	.07	.53	1.25
D.	—	—	.08	.06	.02	.15	.31	2.36	5.57
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.02	.03	.02	—	.08	.60	1.42
Total	—	1.61	1.92	.95	.48	.62	5.58	42.40	100

Table LXVIII.

O1. A.D.C.O.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.56	1.77	.45	.32	.27	4.37	33.23	74.99
B.	—	.13	.52	.27	.11	.18	1.21	9.20	20.76
C.	—	—	.02	—	—	—	.02	.15	.34
D.	—	—	.03	.07	.03	.01	.14	1.06	2.39
E.	—	—	.01	—	—	—	.01	.07	.16
F.	—	—	—	—	—	—	—	—	—
G.	—	.02	.03	.02	.01	—	.08	.60	1.36
Total	—	1.71	2.38	.81	.47	.46	5.83	44.31	100

Table LXVIX.

02a. Turf Ash 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.61	1.40	.50	.27	.28	4.06	30.85	74.09
B.	—	.29	.57	.21	.10	.04	1.21	9.20	2.10
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.03	.07	.02	.01	.13	.99	2.38
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.05	.02	—	—	.08	.60	1.43
Total	—	1.91	2.05	.80	.39	.33	5.48	41.64	100

Table LXX.

02b. Turf Ash, Fallow 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.81	1.79	.64	.28	.26	4.78	36.33	72.97
B.	—	.26	.74	.21	.12	.08	1.41	10.72	21.53
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.10	.08	.02	.01	.21	1.60	3.21
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.12	.03	—	—	.15	1.14	2.29
Total	—	2.07	2.75	.96	.42	.35	6.55	49.79	100

Table LXXI.

O3a. Grass 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.71	1.64	.64	.22	.26	4.47	33.97	70.73
B.	—	.45	.63	.20	.13	.06	1.47	11.17	23.25
C.	—	—	.05	—	—	—	.05	.38	.79
D.	—	—	.03	.10	.02	—	.15	1.14	2.37
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.09	.07	.02	—	.18	1.37	2.86
Total	—	2.16	2.44	1.01	.39	.32	6.32	48.03	100

Table LXXII.

O3b. Grass, Fallow 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.69	1.58	.67	.43	.32	4.69	35.65	73.29
B.	—	.32	.64	.25	.20	.03	1.44	10.94	22.50
C.	—	.02	.01	—	—	—	.03	.23	.47
D.	—	—	.05	.06	.02	.01	.14	1.06	2.18
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.05	.05	—	—	.10	.76	1.56
Total	—	2.03	2.33	1.03	.65	.36	6.40	48.64	100

Table LXXIII.

04. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.15	1.57	.61	.19	.19	3.71	28.19	75.75
B.	—	.14	.44	.25	.08	.03	.94	7.14	19.19
C.	—	—	.03	—	—	—	.03	.23	.61
D.	—	—	.01	.07	.02	.01	.11	.83	2.23
E.	—	—	.03	—	—	—	.03	.23	.61
F.	—	—	.01	—	—	—	.01	.07	.19
G.	—	—	—	.07	—	—	.07	.53	1.42
Total	—	1.29	2.09	1.00	.29	.23	4.90	37.22	100

Table LXXIV.

05. Rotten Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.08	1.32	.75	.26	.15	3.56	27.05	78.25
B.	—	.07	.37	.21	.13	.04	.82	6.23	18.02
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.02	.07	.02	—	.11	.83	2.40
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	.04	—	—	.06	.46	1.33
Total	—	1.15	1.77	1.07	.41	.19	4.55	34.57	100

Table LXXV.

06. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.35	1.57	.75	.32	.18	4.17	31.69	74.62
B.	—	.10	.52	.23	.15	.16	1.16	8.82	20.77
C.	—	—	.07	.01	—	—	.08	.60	1.41
D.	—	—	.02	.08	.01	.02	.13	.99	2.33
E.	—	—	.01	—	—	—	.01	.07	.16
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	.02	—	—	.04	.30	.71
Total	—	1.45	2.21	1.09	.48	.36	5.59	42.47	100

Table LXXVI.

07a. Turf 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.32	1.64	.67	.29	.35	4.27	32.45	72.39
B.	—	.29	.49	.29	.24	.07	1.38	10.49	23.40
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.03	.09	.02	—	.14	1.06	2.36
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.05	.06	—	—	.11	.83	1.85
Total	—	1.61	2.21	1.11	.55	.42	5.90	44.83	100

Table LXXVII.

07b. Turf, Fallow 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.49	1.42	.44	.31	.36	4.02	30.55	70.79
B.	—	.10	.58	.20	.14	.40	1.42	10.79	25.02
C.	—	—	.01	—	—	—	.01	.07	.16
D.	—	—	.02	.07	.02	—	.11	.83	1.92
E.	—	—	.02	—	—	—	.02	.15	.35
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.06	.04	—	—	.10	.76	1.76
Total	—	1.59	2.11	.75	.47	.76	5.68	43.15	100

Table LXXVIII.

08. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.53	1.68	.33	.43	.28	4.25	32.29	75.50
B.	—	.11	.48	.21	.16	.21	1.17	8.89	20.77
C.	—	—	.03	—	—	—	.03	.23	.54
D.	—	—	.02	.08	.03	—	.13	.99	2.31
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	.02	.01	—	.05	.38	.88
Total	—	1.64	2.23	.64	.63	.49	5.63	42.78	100

Table LXXIX.

P1. Urea.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.25	1.50	.52	.32	.35	3.94	29.93	72.83
B.	—	.18	.50	.22	.13	.19	1.22	9.27	22.56
C.	—	—	.02	—	—	—	.02	.15	.36
D.	—	—	.03	.05	.01	.12	.21	1.60	3.89
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.01	.01	—	.02	.15	.36
Total	—	1.43	2.05	.80	.47	.66	5.41	41.10	100

Table LXXX.

P2. Steamed Tomato Haulms.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.45	1.64	.50	.26	.15	4.00	30.40	75.35
B.	—	.14	.50	.20	.16	.16	1.16	8.82	21.86
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.03	.07	.01	—	.11	.83	2.05
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.03	.01	—	—	.04	.30	.74
Total	—	1.59	2.20	.78	.43	.31	5.31	40.35	100

Table LXXXI.

P3. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.52	1.75	.48	.36	.21	4.32	32.83	76.21
B.	—	.09	.46	.18	.17	.17	1.07	8.13	18.87
C.	—	.01	.03	.07	—	—	.11	.83	1.93
D.	—	—	.04	.06	.01	.01	.12	.91	2.11
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.04	.01	—	.05	.38	.88
Total	—	1.62	2.28	.83	.55	.39	5.67	43.08	100

Table LXXXII.

P4. Hay.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.32	1.78	.48	.34	.30	4.22	32.07	76.32
B.	—	.17	.50	.22	.15	.06	1.10	8.36	19.90
C.	—	—	.03	—	—	—	.03	.23	.55
D.	—	—	.03	.06	.01	—	.10	.76	1.81
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.06	.01	—	.08	.60	1.42
Total	—	1.49	2.35	.82	.51	.36	5.53	42.02	100

Table LXXXIII.

P5. Straw.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.38	2.13	.58	.43	.27	4.79	36.40	77.51
B.	—	.15	.55	.25	.19	.02	1.16	8.82	18.78
C.	—	—	.03	—	—	—	.03	.23	.49
D.	—	—	.02	.06	.03	.01	.12	.91	1.94
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	.05	.01	—	.08	.60	1.28
Total	—	1.53	2.75	.94	.66	.30	6.18	46.96	100

Table LXXXIV.

P6. Grass, Urea and Sulphate of Potash.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.29	2.23	.55	.54	.24	4.85	36.86	75.67
B.	—	.11	.55	.23	.20	.17	1.26	9.58	19.67
C.	—	—	.02	—	—	—	.02	.15	.31
D.	—	—	.02	.06	.04	.01	.13	.99	2.03
E.	—	—	.01	—	—	—	.01	.07	.14
F.	—	—	—	—	—	—	—	—	—
G.	—	.01	.05	.08	—	—	.14	1.06	2.18
Total	—	1.41	2.88	.92	.78	.42	6.41	48.71	100

Table LXXXV.

P7. Grass.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.22	1.90	.61	.33	.33	4.39	33.36	76.76
B.	—	.10	.57	.23	.11	.06	1.07	8.13	18.71
C.	—	—	.02	—	—	—	.02	.15	.35
D.	—	—	.05	.06	.02	.01	.14	1.06	2.44
E.	—	—	.02	.03	—	—	.05	.38	.87
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.02	.03	—	—	.05	.38	.87
Total	—	1.32	2.58	.96	.46	.40	5.72	43.46	100

Table LXXXVI.

P8. Control.

Grade.	Lbs. per Plant.							Tons per Acre	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	1.16	1.96	.63	.34	.30	4.39	33.36	73.79
B.	—	.07	.53	.21	.10	.18	1.09	8.28	18.32
C.	—	.03	.03	.01	—	.16	.23	1.75	3.87
D.	—	—	.03	.09	.02	.01	.15	1.14	2.52
E.	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—
G.	—	—	.01	.06	.02	—	.09	.68	1.50
Total	—	1.26	2.56	1.00	.48	.65	5.95	45.21	100

Table LXXXVII.

Q1a. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.38	.68	.25	.23	.15	1.69	12.84	64.04
B.	—	.14	.20	.08	.09	.01	.52	3.95	19.70
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.01	.03	.01	—	.05	.38	1.89
E.	—	.13	.19	.03	.02	—	.37	2.81	14.02
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.01	—	.01	.07	.35
Total	—	.65	1.08	.39	.36	.16	2.64	20.05	100

Table LXXXVIII.

Q1b. Base and Grass.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.66	1.32	.40	.20	.22	2.80	21.28	67.64
B.	—	.09	.52	.30	.09	.02	1.02	7.75	24.63
C.	—	—	.07	—	—	—	.07	.53	1.69
D.	—	—	.03	.09	.01	—	.13	.99	3.15
E.	—	.02	.08	—	—	—	.10	.76	2.42
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.02	—	—	.02	.15	.47
Total	—	.77	2.02	.81	.30	.24	4.14	31.46	100

Table LXXXIX.

Q2a. Turf Ash 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.38	.49	.12	.21	.15	1.35	10.26	50.74
B.	—	.09	.31	.17	.14	—	.71	5.40	26.71
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.01	.08	.01	—	.10	.76	3.76
E.	—	.09	.32	.05	.02	—	.48	3.65	18.05
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.02	—	.02	.15	.74
Total	—	.56	1.13	.42	.40	.15	2.66	20.22	100

Table XC.

Q2b. Turf Ash, Fallow 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.32	.53	.21	.12	.16	1.34	10.18	38.73
B.	—	.04	.22	.15	.08	—	.49	3.72	14.16
C.	—	—	.01	.01	—	—	.02	.15	.57
D.	—	—	.06	.06	.01	—	.13	.99	3.77
E.	—	.37	1.02	.06	.02	—	1.47	11.17	42.50
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.01	—	.01	.07	.27
Total	—	.73	1.84	.49	.24	.16	3.46	26.28	100

Table XCI.

Q3a. Fallow 1923 and 1925, Cropped 1924 and 1926.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.23	.58	.18	.19	.12	1.30	9.88	33.94
B.	—	.01	.38	.17	.09	.02	.67	5.09	17.49
C.	—	—	.02	—	—	—	.02	.15	.51
D.	—	—	.16	.10	.02	—	.28	2.13	7.32
E.	—	.83	.56	.06	.06	—	1.51	11.48	39.44
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.05	—	.05	.38	1.30
Total	—	1.07	1.07	.51	.41	.14	3.83	29.11	100

Table XCII.

Q3b. Urea.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.52	.65	.14	.22	.13	1.66	12.62	52.60
B.	—	.16	.23	.15	.14	.01	.69	5.24	21.81
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.01	.05	.02	—	.08	.60	2.50
E.	—	.23	.39	.08	.01	—	.71	5.40	22.48
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.02	—	.02	.15	.61
Total	—	.91	1.28	.42	.41	.14	3.16	24.01	100

Table XCIII.

Q6. Fallow 1923 and 1924, Cropped 1925 and 1926.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.22	.73	.34	.31	.19	1.79	13.60	55.74
B.	—	.05	.38	.22	.16	.02	.83	6.32	25.90
C.	—	—	—	—	.01	—	.01	.07	.29
D.	—	—	.02	.06	.02	—	.10	.76	3.12
E.	—	.07	.30	.08	.03	—	.48	3.65	14.95
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—	—
Total	—	.34	1.43	.70	.53	.21	3.21	24.40	100

Table XCIV.

Q7. Fallow 1923 and 1925, Cropped 1924 and 1926.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.14	.70	.47	.40	.17	1.88	14.29	52.96
B.	—	.01	.31	.25	.13	.02	.72	5.47	20.28
C.	—	—	—	.01	.01	—	.02	.15	.56
D.	—	—	.06	.01	.03	—	.10	.76	2.82
E.	—	.30	.37	.14	.02	—	.83	6.31	23.38
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—	—
Total	—	.45	1.44	.88	.59	.19	3.55	26.98	100

Table XCV.

Q8a. Grass 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.40	.41	.15	.17	.08	1.21	9.20	45.36
B.	—	—	.21	.21	.11	.01	.54	4.10	20.21
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.01	.02	.01	—	.04	.30	1.48
E.	—	.44	.32	.07	.04	—	.87	6.61	32.59
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	.01	—	—	.01	.07	.36
Total	—	.84	.95	.46	.33	.09	2.67	20.28	100

Table XCVI.

Q8b. Grass. Fallow 1925.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.29	.59	.20	.35	.14	1.57	11.93	45.78
B.	—	.13	.35	.24	.06	.01	.79	6.00	23.02
C.	—	—	.01	—	—	—	.01	.07	.27
D.	—	—	.01	.01	.04	—	.06	.46	1.77
E.	—	.38	.48	.09	.02	—	.97	7.37	28.28
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.03	—	.03	.23	.88
Total	—	.80	1.44	.54	.50	.15	3.43	26.06	100

Table XCVII.

Q9a. Grass only.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.27	.91	.15	.29	.15	1.77	13.45	49.86
B.	—	.02	.38	.23	.12	.02	.77	5.85	21.68
C.	—	—	.01	—	—	—	.01	.07	.27
D.	—	—	.06	.02	.01	—	.09	.68	2.52
E.	—	.35	.54	.02	—	—	.91	6.93	25.68
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—	—
Total	—	.64	1.90	.42	.42	.17	3.55	26.98	100

Table XCVIII.

Q9b. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.34	.53	.13	.12	.14	1.26	9.58	45.85
B.	—	.15	.25	.13	.09	.01	.63	4.79	22.93
C.	—	—	.01	—	—	—	.01	.07	.34
D.	—	—	.06	.03	—	—	.09	.68	3.26
E.	—	.28	.39	.06	.03	—	.76	5.77	27.62
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—	—
Total	—	.77	1.24	.35	.24	.15	2.75	20.89	100

Table XCIX.

Q10a. Control.

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.29	.35	.31	.18	.13	1.26	9.58	57.31
B.	—	.02	.25	.19	.09	.01	.56	4.26	25.48
C.	—	—	—	—	—	—	—	—	—
D.	—	—	.01	.02	.01	—	.04	.30	1.79
E.	—	.13	.17	.03	—	—	.33	2.51	15.00
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	.01	—	.01	.07	.42
Total	—	.44	.78	.55	.29	.14	2.20	16.72	100

Table C.

Q10b. Base ($7\frac{1}{2} : 5 : 10$).

Grade.	Lbs. per Plant.							Tons per Acre.	Per Cent. of Total.
	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	—	.82	1.34	.38	.48	.32	3.34	25.38	67.64
B.	—	.08	.54	.27	.24	.02	1.15	8.74	23.29
C.	—	—	.01	—	—	—	.01	.07	.18
D.	—	—	.04	.08	.02	—	.14	1.06	2.82
E.	—	.24	.06	—	—	—	.30	2.28	6.07
F.	—	—	—	—	—	—	—	—	—
G.	—	—	—	—	—	—	—	—	—
Total	—	1.14	1.99	.73	.74	.34	4.94	37.53	100

Details of Manurial Treatments in the Tomato Experiments.

(1) Lime.

All Series except Q received two tons Ground Caustic Lime per acre.

(2) Stable Manure.

Series H.M.N.O. and P. received 30 tons Stable Manure per acre.

Series G. received varying amounts as detailed in the experiment.

(3) Base Fertiliser.

Series G.H. and M. received $\frac{3}{4}$ lb. per sq. yd. of the following mixture:—

- 1 part Bone Meal.
- 1 part Bone Flour.
- 1 part Ground Hoof and Horn.
- 1 part Sulphate of Potash.

Series N.O. and P. received the following per sq. yd. :—

- $\frac{1}{4}$ lb. Bone Meal.
- $\frac{1}{4}$ lb. Bone Flour.
- $\frac{1}{4}$ lb. Sulphate of Potash.

(4) Top-dressing.

Series G.H.M.N.O. and P. received 2 ozs. per sq. yd. of the following mixture every 14 days:—

- 3 parts Sulphate of Ammonia.
- 2 parts Dried Blood.
- 7 parts 30% Superphosphate.
- 5 parts Pure Dissolved Bones.
- $\frac{1}{2}$ part Bone Flour.
- $2\frac{1}{2}$ parts Sulphate of Potash.

This gave 5% Ammonia, 24% Total Phosphates, 12% Soluble Phosphates and 7% Potash on examination.

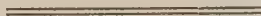


Table CI.

Manures applied in Series J and K.

Plot.	TITLE.	Base Manure in Lbs. per sq. yd.							† Top-dressing in Lbs. per sq. yd.			
		Lime.	Stable Manure.	Basic Slag.	Bone Meal.	Bone Flour.	Ground Hoofs.	Sulphate of Potash.	Super-phosphate.	Sulph. of Ammonia.	Nitrate of Soda.	Sulph. of Potash.
J1a	Stable Manure, Sulphate of Ammonia and Sulphate of Potash	1.0	14	—	—	—	—	—	—	0.1	—	0.05
J1b	Stable Manure with Grass Cuttings	1.0	14	—	—	—	—	—	—	0.1	—	0.05
J2a	Unmanured	1.0	—	—	—	—	—	—	—	—	—	—
J2b	Unmanured	1.0	—	—	—	—	—	—	—	—	—	—
J2c	Stable Manure	1.0	28	—	—	—	—	—	—	—	—	—
J3a	Sulphate of Potash only	1.0	—	—	—	—	—	—	—	—	—	—
J3b	2½% Nitrogen and 10% Potash	1.0	—	—	—	—	—	—	—	0.2	—	0.4
J3c	5% Nitrogen and 10% Potash	1.0	—	—	—	—	—	—	—	0.4	—	0.4
J3d	7½% Nitrogen and 10% Potash	1.0	—	—	—	—	—	—	—	0.6	—	0.4
J4a	Sulphate of Potash and Superphosphate	1.0	—	—	—	—	—	—	0.3	—	—	0.4
J4b	2½% Nitrogen, 5% Superphosphate, 10% Potash	1.0	—	—	—	—	—	—	0.3	0.2	—	0.4
J4c	5% Nitrogen, 5% Superphosphate, 10% Potash	1.0	—	—	—	—	—	—	0.3	0.4	—	0.4
J4d	7½% Nitrogen, 5% Superphosphate, 10% Potash	1.0	—	—	—	—	—	—	0.3	0.6	—	0.4
J5a	Complete Artificial (Formula I.)	1.0	—	0.4	—	—	—	0.1	1.3	0.4	—	0.3
J5b	Complete Artificial and Grass	1.0	—	0.4	—	—	—	0.1	1.3	0.4	—	0.3
J6a	Complete Artificial (II.) without Phosphates	1.0	—	—	—	—	—	0.1	—	0.4	—	0.3
J6b	Complete Artificial (II.) with 8% Phosphates	1.0	—	—	—	—	—	0.1	0.8	0.4	—	0.3
J6c	Complete Artificial (II.) with 16% Phosphates	1.0	—	—	—	—	—	0.1	1.7	0.4	—	0.3
J6d	Complete Artificial (II.) with 24% Phosphates	1.0	—	—	—	—	—	0.1	1.3	0.4	—	0.3
J7a	Complete Artificial (II.) without Nitrogen	1.0	—	0.4	—	—	—	0.1	—	—	—	0.3
J7b	Complete Artificial (II.) with 5% Nitrogen	1.0	—	0.4	—	—	—	0.1	1.3	0.4	—	0.3
J7c	Complete Artificial (II.) with 7½% Nitrogen	1.0	—	0.4	—	—	—	0.1	1.3	0.6	—	0.3
J7d	Complete Artificial (II.) with 10% Nitrogen	1.0	—	0.4	—	—	—	0.1	1.3	0.8	—	0.3
J8a	Complete Artificial (II.) without Potash	1.0	—	0.4	—	—	—	—	1.3	0.4	—	—
J8b	Complete Artificial (II.) with 7½% Potash	1.0	—	0.4	—	—	—	—	1.3	0.4	—	0.3
J8c	Complete Artificial (II.) with 10% Potash	1.0	—	0.4	—	—	—	—	1.3	0.4	—	0.4
J8d	Complete Artificial (II.) with 12½% Potash	1.0	—	0.4	—	—	—	—	1.3	0.4	—	0.6
*K1	Double Complete Artificial (Formula I.)	1.0	—	0.8	—	—	—	0.2	1.0	0.4	0.4	0.4
K2	Unmanured	1.0	—	—	—	—	—	—	—	—	—	—
K3	Complete Artificial (I.) with Standard	1.0	14	0.4	0.5	0.5	0.5	0.6	0.5	0.2	0.2	0.2
K4	Complete Artificial (I.) with Dung	1.0	7	0.4	—	—	—	0.1	0.5	0.2	0.2	0.2
K5	Complete Artificial (I.)	1.0	—	0.4	—	—	—	0.1	0.5	0.2	0.2	0.2
K6	Complete Artificial (I.) without Phosphates	1.0	—	—	—	—	—	—	—	—	—	—
K7	Complete Artificial (I.) without Nitrogen	1.0	—	0.4	—	—	—	0.1	0.5	0.2	0.2	0.2
K8	Complete Artificial (I.) without Potash	1.0	—	0.4	—	—	—	—	0.5	—	—	—

* Half of each plot received 14 lbs. Grass Cuttings per sq. yd. in addition.

† The Top-dressing was applied in eight equal instalments.

ERRATA.

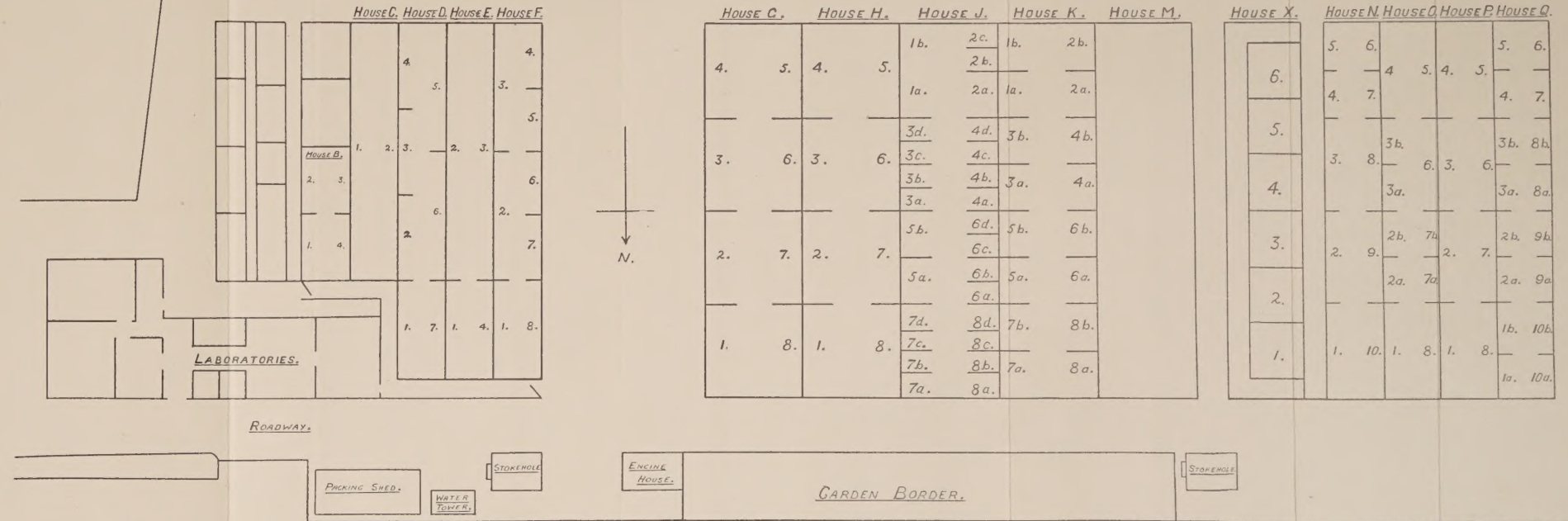
On Page XVI., Table XXXII., please read heading:
“Complete Artificials without Phosphate”
instead of “Complete Artificials without Nitrogen” as printed.

DIAGRAM TO SHOW ARRANGEMENT OF EXPERIMENTAL

PLOTS. 1926.

TOMATO HOUSES.

CUCUMBER HOUSES.



h. Corbett.

